The extent to which occupational commitment explains variances in ERP success

Thesis

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The extent to which Occupational Commitment explains variances in ERP success

Thesis submitted in accordance with the requirements of
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by
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ABSTRACT

The objective of this research was to investigate the relationship between Occupational Community of Practice Strength of Commitment and Perceived Usefulness of ERP systems, as mediated by the barriers to the knowledge transfer process, adaptation and perceptions of work practice compatibility. A Relativist approach was chosen, using a questionnaire as the primary data collection method, and PLS-SEM as the primary data analysis method.

A survey instrument that was designed to measure the relationships between these variables was administered. The results led to the conclusions that Occupational Strength of Commitment had little effect on Work Practice Compatibility, but that Compatibility with Preferred Practices had a significant effect on Perceived Usefulness. It therefore became evident that in order to enhance ERP success, it was necessary to focus on the variables that influence perceptions of Compatibility with Preferred Practices when implementing ERP systems. These variables were identified based on the results of the data, and then synthesized into a conceptual model of ERP success in order to meet the research objective.

Due to the limitations of the study, further research is recommended to test this conceptual model. The hypothesized relationships that could not be supported by the data are also identified for further research.

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21 May 2012

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ABBREVIATIONS

Abbreviation	Description
ACS	Absorptive Capacity of System Domain
ACW	Absorptive Capacity of Work Domain
AR	Arduous Relationship
ASP	Application Service Provider
ERP	Enterprise Resource Planning
IS	Information Systems
IT	Information Technology
MOT	Motivation
OCoP	Occupational Communities of Practice
OCS	Occupational Communities of Practice Strength of Commitment
PA	Process Adaptation
PU	Perceived Usefulness
QIU	Quality in Use
RA	Relative Advantage
RES	Resistance
SA	System Adaptation
SaaS	Software as a Service
SC	Source Credibility
SU	Shared Understanding
UK	Unproven Knowledge
WPC	Work Practice Compatibility
WPE	Compatibility with Existing Practices
WPI	Compatibility with Imposed Practices
WPP	Compatibility with Preferred Practices
WPT	Compatibility with Past Experiences with Technology

CHAPTER 1

INTRODUCTION

"Consideration and planning of any new or changed use of IT should include specific analysis to... identify the people "communities" and their collective behaviours – their culture and climate..."

Mark Toomey – *Waltzing with the Elephant, p.228*

1.1. Introduction

This study investigates the extent to which occupational strength of commitment explains variances in Enterprise Resource Planning (ERP) success, using a Relativist approach. This chapter provides an overview of the study, including the motivation for the study (1.2), the aims and objectives (1.3), the research design and methodology (1.4), the findings (1.5) and the limitations of the study (1.6). The chapter concludes with an outline of the thesis (1.7).

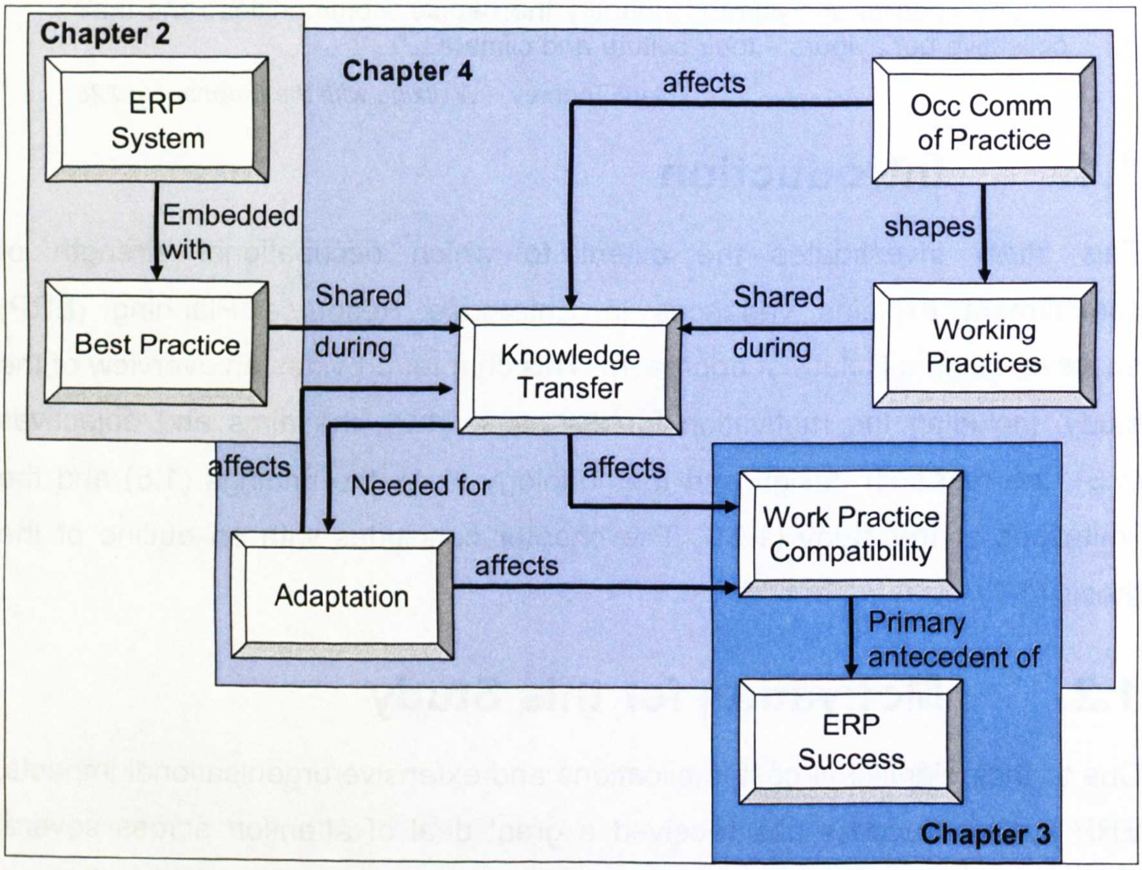
1.2. Motivation for this Study

Due to their significant cost implications and extensive organisational impacts, ERP system success has received a great deal of attention across several disciplines. Prior research has identified numerous critical success factors, whilst industry and academia have explored the potential of various innovative strategies to enhance success.

However, almost 75% of companies are still reporting that their ERP systems have fallen short of their expectations, with negative outcomes including problems of data inaccuracies, resistance by users, customer frustration, high staff turnover and ultimately a loss in profits. To date, the reasons for this high failure rate are still unclear and are being examined.

Review of the literature brings to light a set of propositions that, when viewed together, suggest a previously unexplored reason worth investigating. ERP system functionality is provided in terms of "Best Practice" at the industry level. In contrast, actual work practices are strongly influenced by occupational communities of practice, suggesting that misfits will arise. In addition, members of these communities display characteristics that could strengthen barriers to knowledge transfer. These propositions are summarised in section 5.2.

Figure 1: Motivation for this study



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This suggests that investigating the problem of ERP success through the lens of occupational communities of practice could reveal an unidentified, and significant, explanatory factor of ERP adoption outcomes. Thus, the findings of this research study could help to enhance the potential for ERP success.

Although ERP system success has received a great deal of attention from academia and industry, the reasons for the continued high failure rate is still not fully understood. The continued and growing investments and reliance on ERP technologies by organisations across the globe reflects the importance of this research.

1.3. Aims and Objectives

This research study investigated the relationship between Occupational Communities of Practice Strength of Commitment (OSC) and ERP system success by testing

- The relationship between Occupational Strength of Commitment (OSC) and the barriers to the knowledge transfer process
- The relationship between the barriers and Work Practice Compatibility
- The relationship between system / organisational adaptation, barriers to the knowledge transfer process, and Work Practice Compatibility.
- The relationship between Work Practice Compatibility and self-perceived individual performance.

1.4. Research Design and Methodology

Three main approaches to epistemology and ontology in the social sciences were reviewed to identify an appropriate approach for this study, namely Positivism, Relativism and Social Constructionism. Relativism was deemed the most appropriate ontological and epistemological position for this research because

- It is not possible to conduct a true experiment as required by the Positivist approach. In order to conduct an experiment it is necessary to be able to manipulate the independent variable(s) to be able to establish whether or not it has an effect on the dependent variable (Bryman & Bell, 2003; Hair, Babin, Monet, & Samouel, 2003). However, in the case of this study, the independent variables under investigation could not be manipulated (Bryman & Bell, 2003). Relativist approach makes use of correlational research which observes the co-occurrence of variables to determine whether there is a correlation between the variables (Field, 2009. p.15), which can be achieved in the context of this study.

- Technology is viewed as a socio-technical system, meaning that work systems are composed of both human and technological elements, and that the interaction of people (a social system) with tools and techniques (a technical system) should be the central issue. The impacts that the system has on its users are dependent on a variety of user characteristics, including their prior knowledge, experiences and beliefs. A Social Constructionist approach aims to understand these impacts through conversations and sense-making. However, these impacts are also objective entities, and the goal of information systems research in this instance is to identify the key user characteristics that influence these impacts. Thus a Relativist approach is deemed more appropriate.

- It is the researcher's world view that there is a reality that exists external to social actors. However, individuals may understand that reality differs based on the meanings that they ascribe to it, resulting from their own beliefs, values and experiences.

A survey research design was consequently selected for this study. A questionnaire formed the primary data collection method combined with quantitative analysis methods. Factor Analysis was used to test the validity of the instrument during the pilot study. Partial Least Squares was used to simultaneous assess the structural and measurement model in the main study. . This will be discussed in more detail in Chapter 6.

1.5. Findings

Support was found for only two of the six hypotheses relating to the relationship between strength of commitment and the barriers to knowledge transfer. Only one of the hypotheses relating to the relationship between adaptation and knowledge transfer barriers was supported by the data. Similarly, 14 of the 24 hypotheses pertaining to the relationships between the knowledge transfer barriers and Work Practice Compatibility were supported.

Contrary to expectations, users' strength of occupational commitment did not appear to play a significant explanatory role in variances in ERP success, either directly, or through the other hypothesized variables. However, analysis of the results led to the conclusion that, in the context of this study at least, Compatibility with Preferred Practices is of significant importance, explaining 57% of the variance in user task performance. In contrast, and contrary to expectations, the other three dimensions of Work Practice Compatibility had little or no effect on the dependent variable.

1.6. Limitations of the Study

Two main categories of limitations of this study have been identified, each of which provides opportunities for further research in this area. These are as follows:

- Domain and Methodology Limitations

Four limitations were identified as a result of the study domain and data collection methods used in this research. Firstly, not all of the factors identified in the literature were included for investigation. Secondly, it is acknowledged that the results could be affected as a result of self-report bias. Similarly, the use of the Internet to collect survey data may have affected the data. Finally, the small sample size added some limitations in terms of being able to partition the data to investigate the effects of various external factors on the hypothesized relationships.

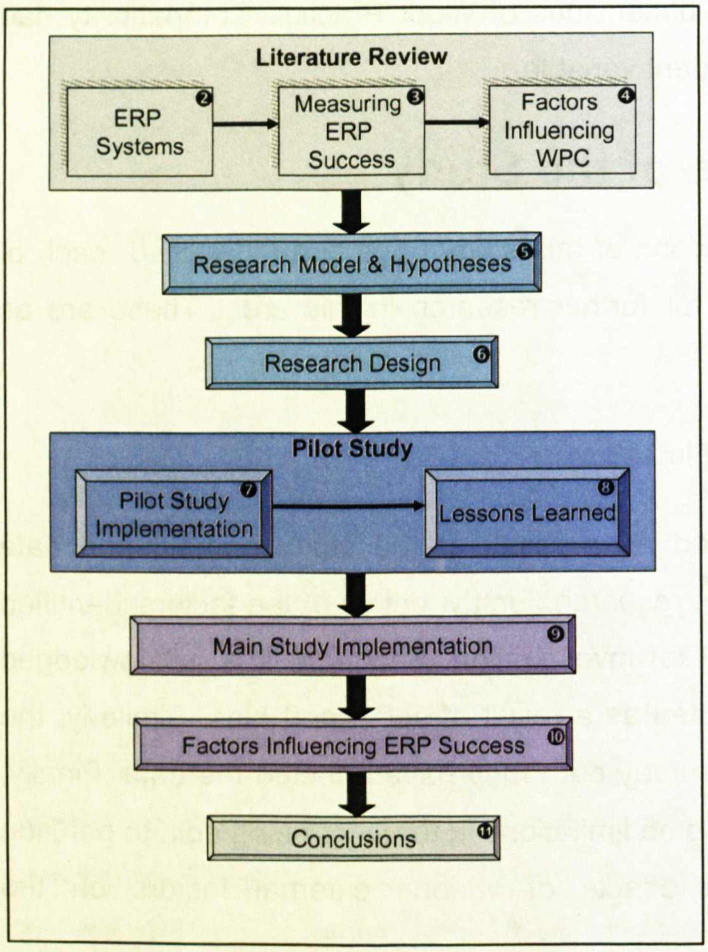
- Validation of Findings

Not all of the hypotheses were supported by the data, and in some cases, the data reflected results that were contradictory to the literature. In these cases, further research studies have been identified to confirm the results of this study, and/or to validate the explanations provided for the observed correlations.

Limitations and future work are discussed in detail in section 11.4.

1.7. Thesis Outline

Figure 2: Thesis Outline



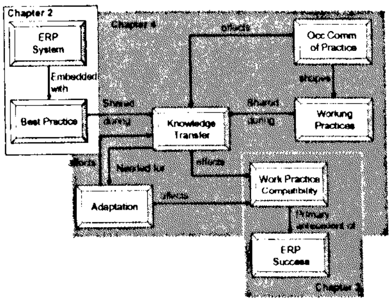
As reflected in Figure 2, the dissertation comprises eleven chapters. This research is multidisciplinary in that it needed to integrate concepts and theories from several disciplines, including occupational communities of practice, enterprise resource planning systems, information systems success, the knowledge transfer process and human-computer interaction. The literature review, aimed to identify what is already known about the problem domain, and to position this study in terms of an existing gap in the extant body of knowledge, resulting in a set of propositions on which this research is predicated. As reflected in Figures 1 and 2, the literature review is discussed over three chapters.

Chapter 2 begins the literature review with a detailed discussion of enterprise resource planning systems. Chapter 3 focuses on a review of the Information Systems Success literature, where it is argued that Quality in Use, measured in terms of user task performance is an appropriate proxy for measuring ERP success. Furthermore, Work Practice Compatibility (WPC) was identified as the primary critical factor for meeting user needs, and thus enabling task performance and the expected benefits of adopting an ERP system. Chapter 4 reviews the literature surrounding the factors that influence work practice compatibility within the ERP context. Three distinct sets of factors, namely

Adaptation, the barriers to knowledge transfer and occupational communities of practice are reviewed, together with their interdependencies. Adaptation is discussed in terms of both system-based and process-based adaptation. The knowledge transfer process is discussed in depth, and six barriers to the process are identified for inclusion into the research model. Occupational communities of practice are discussed in terms of their influence on user needs and how member characteristics can hinder the knowledge transfer process through strengthening of the barriers.

The research model and hypotheses are explicated in Chapter 5 and the research design and methodology are described in Chapter 6. Details of the pilot study, the results and lessons learned are discussed in Chapter 7. The main study analysis and interpretation of the results are detailed in Chapters 9 and 10. Chapter 11 concludes the dissertation by summarising its contribution to the body of knowledge and to research in ERP implementation success in particular. Limitations of the study are recognised and suggestions for future research are identified based on the limitations and results of this research.

In the next three chapters, a review of the prior research relevant to this study is presented



CHAPTER 2

ENTERPRISE RESOURCE PLANNING SYSTEMS

"It's not computer literacy that we should be working on, but sort of human-literacy. Computers have to become human-literate."

Nicholas Negroponte

2.1. Introduction

Due to the substantial benefits expected from their use, ERP systems are now considered to be business-critical systems with the majority of large organisations and many small-to-medium sized organisations having adopted them (Arnold, 2006; H. Klaus, Rosemann, & Gable, 2000; Rosemann, 2004). This chapter reviews the extant body of knowledge surrounding these systems.

The chapter begins with an overview of ERP systems (2.2) which includes the various definitions and life cycles that have been proposed in the literature, as well as the different types, implementation approaches and operational approaches that are available for selection. The expected benefits of ERP system adoption are then discussed (2.3), followed by a review of the characteristics that are required in order to provide these benefits (2.4). The critical success factors for ERP system implementation are examined next (2.5). The chapter concludes with a review of the success rates that have been achieved to date, and the costs attached to unsuccessful implementation initiatives (2.6).

2.2. Overview of ERP Systems

Enterprise Resource Planning (ERP) systems evolved from material requirements planning (MRP) and manufacturing resourcing planning (MRPII) systems (H. Klaus et al., 2000). The primary purpose of MRP, developed in the late 1970s, was to more efficiently calculate the materials required for production. MRPII provided additional functionality such as sales planning, capacity management and production scheduling.

However, other business functions within the organisation could not be supported by MRPII. As a result, organisations made use of several different applications to collect, organise and report on the data that was required for managerial purposes (Davenport, 1998). This data was not kept in a single repository, but rather spread over a multitude of different databases, often across different locations, that made integration and consolidation inefficient and error-prone. ERP systems were developed to solve the problem of information fragmentation (Davenport, 1998) through the integration of other business functionality (Koch, 2002).

Modern ERP systems are expected to have the ability to support the core organisational business activities of Sales and Marketing, Production and Materials Management, Accounting and Finance and Human Resources (Satzinger, Jackson, & Burd, 2007). Add-on modules, such as Supply Chain, Warehouse Management, Reporting, Business Intelligence and Customer Relationship Management, have been developed in order to provide support across all functions of the organisation using a single database (Davenport, 1998; Koch, 2002; Monk & Wagner, 2006; Olson, 2004).

2.2.1. Definitions

Resolving the information fragmentation problem within organisations required specific criteria to be incorporated into ERP systems. These criteria, in turn, have become embedded in the many different definitions of ERP systems proposed in the literature (Buonanno et al., 2005; Kumar, Maheshwari, & Kumar, 2003), for example: ERP systems have been defined as:

- standard, customisable off-the-shelf packaged software that are generic enough for use in any organisation (H. Klaus et al., 2000; Kumar et al., 2003);
- consisting of core and add-on modules that provide support across all functional areas of an organisation, including accounting and finance, human resources, manufacturing, sales and marketing, and warehousing (V Botta-Genoulaz & Millet, 2006; Robey, Ross, & Boudreau, 2002);
- being built on a common database, thus providing the ability to integrate data flows across all functional areas of the organisation (V Botta-Genoulaz & Millet, 2006; Davenport, 1998; Olson, 2004); and
- standardising business processes across the entire organisation (Gable, Sedera, & Chan, 2003; Markus, Axline, Petrie, & Tanis, 2000; E Wagner & Newell, 2004)

In addition, distinction is made between the concept of ERP and ERP systems. APICS defines ERP as "A method for the effective planning and control of all resources needed to take, make, ship, and account for customer orders in a manufacturing, distribution, or service company" (APICS., 2002a). ERP is thus considered to be a business methodology that provides a framework within which business activities are performed. An ERP system, in contrast, provides computer-based support for the collection, processing, retrieval and reporting of information necessary for the effective implementation of those activities.

2.2.2. Types of ERP Systems

ERP Tiers is a method of classification used by consultants and vendors to categorise different types of ERP systems in terms of the size of the organisation (ERPandMore.com, 2005). Four tiers have been identified by industry, as follows:

- **Tier 1** – ERP systems within this category are designed for large organisations. Within the ERP context, large organisations are viewed as companies with revenues in excess of USD 200 million, that have several sites which are usually geographically dispersed and within multiple companies. Due to the recent merger and acquisition activities within the ERP vendor industry, there are only three vendors that provide Tier 1 offerings. These are SAP, Oracle and Microsoft.

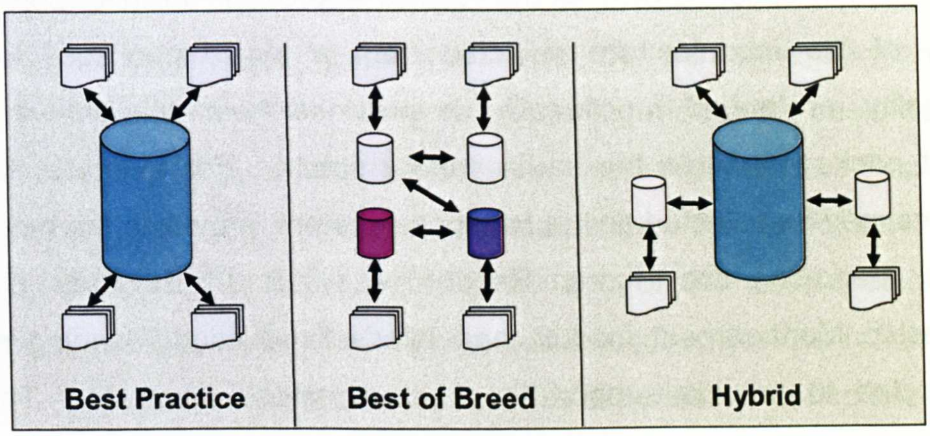
- **Tier 2** – this is the largest market of all the tiers in terms of the number of potential customers. ERP systems that are designed for this market cater to the needs of the mid-size organisation: companies with revenue between USD 20 million and USD 200 million, consisting of either one, or a few, localised sites, with a maximum of 100 users of the system. Tier 2 software is provided by many vendors, such as Infor, Epicor, Sage and Lawson, as well as by the vendors that offer Tier 1 solutions.
- **Tier 3** – software falling into this category is designed for small businesses which generally have revenues of less than USD 40 million, comprise of only one site., and have between 5 and 30 users. The most popular system catering to the needs of Tier 3 companies is Microsoft Great Plains, recently renamed as Dynamics GP.
- **Tier 4** – relates to entry-level or basic accounting system software such as AccPac, QuickBooks and Peach Tree. Organisations with revenues up to USD 2 million find these systems to be adequate for their needs

Although there is no single ERP vendor that dominates the market, SAP, Oracle and Microsoft are the three major vendors that were the most selected for implementation during 2009 and 2010 (Kimberling, 2011). This is probably due to their ability to cater for both Tier 1 and Tier 2 organisations (ERPandMore.com, 2005)

2.2.3. Implementation Approaches

ERP software vendors differentiate their products not only through their ability to cater to different tiers, but also by emphasising different strengths in their products. For example, PeopleSoft (now part of the Oracle stable of offerings) is reputed to have the strongest Human Resources support, whilst SAP is known for its Production Planning and Materials Management functionality and processes (Monk & Wagner, 2006). The importance of each module is derived from the industry (for example, automotive, pharmaceutical, travel) to which the organisation is affiliated, as well as the nature of the organisation.

Figure 3: ERP Implementation Approaches
(Source: Adapted from (Satzinger et al., 2007, Online Supplemental, Chapter 2, p.13))



For example, a manufacturing organisation would ascribe the most importance to the Production Planning and Materials Management modules of their intended ERP system, and would be thus likely to select the package that offers the best support for that business function. This implementation approach is known as the **Best Practice** or **Comprehensive Package** approach. Best practice represents the way in which an ERP vendor believes that transactions should be carried out for maximum efficiency within a particular industry (Satzinger et al., 2007). These Best Practices are designed into the system so that it is necessary for the organisation to adopt the underlying business model and processes in order to make use of the system. Best practice is discussed in more detail in section 2.4.1.

An alternative approach to implementation is known as **Best of Breed**. Because ERP systems are modular in design, it is not always necessary to implement a single package. Companies are able to select different modules from a variety of systems, across vendors, to best suit their specific needs. Thus, for example, a manufacturing organisation that is in constant negotiation with trade unions on staff salaries would probably consider the production and human resources modules to be the most important in their ERP system. In this case, the organisation may choose to select the relevant modules from different systems and/or vendors. As reflected in Figure 3, implementation would therefore require the different modules to be linked to provide an integrated system.

Combining the Best of Breed and Best Practice approach results in a third implementation option known as the **Hybrid** approach. In this approach, the majority of the modules are selected from a single package. Additional functionality, or "better" functionality, is provided from different vendors or different packages within the same vendor stable. For example, Microsoft Dynamics may be selected as the backbone system, providing the modules for Finance, Marketing and Human Resources, whilst JD Edwards' Customer Relationship Management module and Infor's Production Planning modules are selected to provide support for those business functions. The three implementation approaches are graphically depicted in Figure 3.

2.2.4. Operational Approaches

In addition to a choice of implementation approaches, companies are also able to select from three operational approaches when implementing an ERP system. These are on-premise, ASP (off-site) and SaaS.

Traditionally, the deployment of software has always required installation of the system onto the computer systems of the adopting organisation once it has been purchased. Known as the On-Premise operational approach, this model required considerable investment in the cost of the software, as well as the hardware and architecture that was required for running the software. The total cost of ownership (TCO) of on-premise ERP systems also needs to include the costs associated with annual licenses, upgrades, support and maintenance agreements, which together are multiples of the original cost of the software.

The Internet has enabled two alternative options, where ownership and management of the package are outsourced to a service provider. In the early 1990's, Application Service Providers (ASPs) offered hosted applications delivered over the Internet as a way of reducing this cost of ownership. Although the client still owned the software and had to pay the usual license fees, the ASP model allowed the clients to either install this software, or move their existing and legacy systems, on to the ASP servers, thus reducing their own running costs. The ASP model, however, was unsuccessful because of the substantial architectural resources that were required, which eventually became unsustainable.

The second internet-based operational model, Software-as-a-Service (SaaS), evolved from the ASP model. Using this operating model, the customer is able to "rent" rather than purchase the software from the vendor. Because the software is still owned by the vendor and installed on the vendor's servers, the user organisation does not have to incur any of the additional hardware, architectural, maintenance and support costs required for the running of the software. Instead, SaaS vendors provide clients access to the software via the Internet. This is also known as the multi-tenancy approach, as each customer "rents" the same underlying code, similar to many tenants cohabiting a single building.

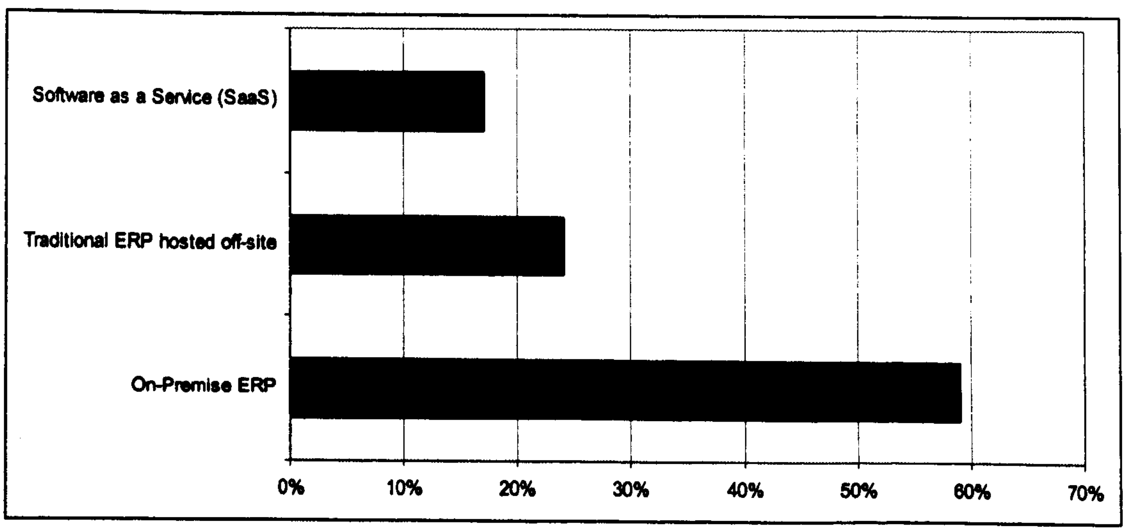
Table 1: Advantages of SaaS over On Premise ERP software

Advantage	Description
Low cost of entry	No license fee – cost is per user per month Eliminates need for acquisition of additional hardware and infrastructure
Lower overhead costs	Eliminates need to - employ IT staff - maintain hardware and infrastructure - pay for support and maintenance
Increased accessibility	Data and functionality can be accessed from any location at any time, thus enabling enhanced productivity across geographically dispersed locations.
Defined and predict-able spend	SaaS operates on a fixed, pre-defined charge, thereby assisting with cash-flow forecasting.
Security	Up-to-date security, intrusion detection, and disaster recovery plans, whilst often prohibitively expensive for a single user organisation, are mandatory for vendors offering SaaS.

Whilst the advantages to using SaaS are numerous (see Table 1) (Dubey & Wagle, 2007; Frick & Schubert, 2009; Ju, Wang, Fu, Wu, & Lin, 2010), one distinct disadvantage is that the model offers very limited customisation – the underlying code is the same for all customers and cannot be customised to suit an individual customer. Customisations in the form of additional features and functions are made based on customer feedback, and become part of the underlying source code which is then made available to all customers (Levinson, 2007). Customisation is discussed in more detail in section 4.2.

On-premise ERP is still the most popular deployment approach and is expected to remain so for the foreseeable future. A recent Forrester survey of 2 403 IT decision makers showed that only 15% of organisations plan to implement ERP via SaaS before 2013, of which two-thirds will use SaaS to complement existing on-premise ERP (Williams, 2011). The Aberdeen study found that SaaS deployment has reached an average of 9% among companies of all sizes by 2010. Adoption is highest at 17% for companies with less than $50 million in annual revenue, and lowest at 4% for larger companies (All, 2011) Similarly, Gartner reported that spending on on-premise ERP was more than 8 times higher than spending on SaaS in 2010. These predictions are consistent to the findings reflected in Figure 4: of the 185 companies that responded to the survey during 2010, 59% were using on-premise ERP, 24% were using off-premise ERP, and only 17% had adopted the SaaS approach.

Figure 4: Popularity of ERP Operational Approaches
(Source: (Kimberling, 2011))

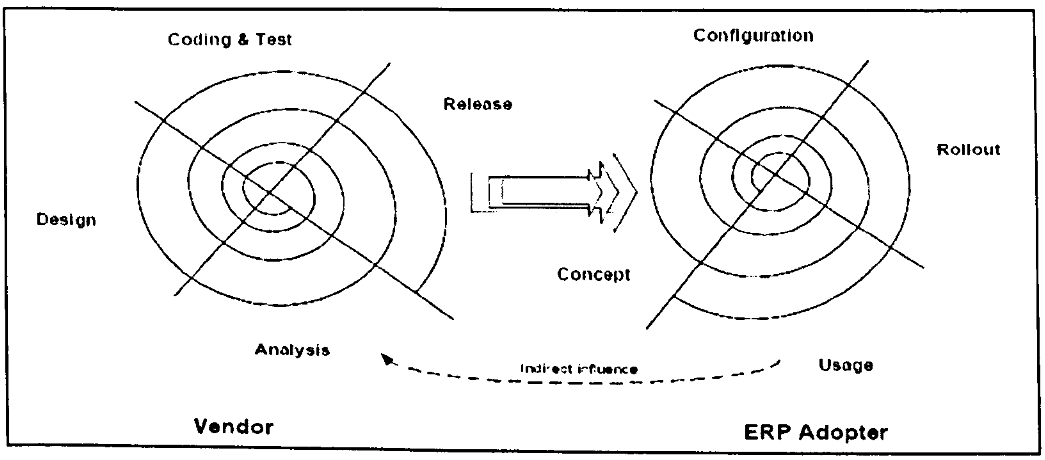


2.2.5. ERP Life Cycle

Although ERP systems are a subset of traditional information systems, they are distinct in that they require two life cycles to fully represent the phases that they pass through during their lifetime. The traditional information system life cycle (SLC) focuses on the activities performed by a company developing, implementing and maintaining software for its own internal use (Brehm & Markus, 2000). However, ERP systems are off-the-shelf packages that are developed outside the adopting company. To fully represent both the development and implementation activities related to ERP systems, the ERP life cycle should consist of two separate, but interlinked sub-life cycles. Figure 5 illustrates two such life-cycles: the Vendor life cycle represents the development activities, whilst the ERP Adopter life cycle encompasses the activities relating to system implementation and use.

Numerous ERP adopter life cycles have been proposed in the literature. A synthesis of these alternative models suggests that the activities can be categorised into the three phases of Decision, Implementation and Usage.

Figure 5: The Divided ERP Life Cycle
(Source: (Brehm & Markus, 2000))



These phases and their activities are summarised in Table 2, and are briefly described as follows:

(1) Decision – The adopter life cycle begins with an organisational decision to acquire an ERP system. Thereafter, a specific ERP system is selected. This phase is considered complete when the selected software has been acquired.

(2) Implementation – This phase consists predominantly of project management activities that begin once the software has been acquired,

continues on to configuration activities which formats the system to the specific needs of the adopter organisation and concludes once the software has been installed in the adopter organisation.

(3) Usage – It is during this phase that actual system use takes place by end users to perform their respective tasks. This phase also commonly includes maintenance activities, such as enhancements to the software to meet the changing needs of the organisation, and continues until the decision is made to replace the system.

The outcomes of one phase become the starting conditions for the next phase, suggesting that the outcomes of the previous phase can influence the chances for success of the next phase (Markus & Tanis, 2000). The life cycle phases relevant to this study are addressed in section 3.2.4.

Table 2: ERP Adopter Life Cycles

Source	Decision	Implementation	Usage
Esteves & Pastor (2001)	▪ Adoption Decision ▪ Acquisition	▪ Implementation	▪ Use & Maint. ▪ Evolution ▪ Retirement
Brehm & Markus, (2000)	▪ Concept	▪ Configure ▪ Rollout	▪ Usage
Markus & Tannis (2000)	▪ Chartering	▪ Configure ▪ Rollout	▪ Shakedown ▪ Onwards and Upwards
Sedera, Rosemann & Gable (2001)	▪ Selection ▪ Design	▪ Implementation	▪ Stabilisation ▪ Continuous Improvements ▪ Transformation
Somers & Nelson (2003)	▪ Initiation ▪ Adoption	▪ Adaptation	▪ Acceptance ▪ Routinization ▪ Infusion

2.3. Benefits of ERP System Adoption

By solving the information fragmentation problem that organisations were experiencing, ERP systems provide many benefits to adopting organisations

(Davenport, 1998). Markus & Tanis (2000) conducted a survey which identified reasons for system adoption, the most prominent of which are summarised in Table 3.. Each of these reasons can be correlated to one or more of the criteria identified in the ERP definitions listed above. For example, a common database prevents data inaccuracies resulting from data redundancy, and ensuring integrated data flows throughout the organisation is expected to enhance accessibility and timeliness of data. The ability to purchase the system off-the-shelf means that companies can reduce the cost of maintaining software through outsourcing, whilst the modularity of available functionality means that organisations do not pay for functions that they do not want or need, thus reducing the financial impact of their software investment.

Table 3: Reasons for Adopting ERP Systems
(Adapted from Markus & Tanis (2000)

Category	Reasons
Technical	▪ Integrate applications cross- functionally ▪ Eliminate redundant data entry and concomitant errors and difficulty analyzing data ▪ Reduce software maintenance burden through outsourcing
Business	▪ Improve informal and/or inefficient business processes ▪ Clean up data and records through standardization ▪ Reduce business operating and administrative expenses ▪ Standardize procedures across different locations ▪ Present a single face to the customer

The standardisation of business processes across the organisation is expected to result in improved business processes and the ability to present a single face to its customers, ultimately resulting in enhanced organisational performance through increased productivity and reduced costs (Davenport, 1998; Robey & Azevedo, 1994)

Thus, these criteria create expectations of benefits for the adopting organisation, and it is these benefits that underlie the reasons for adoption.

2.4. Characteristics

In order to provide these benefits, ERP systems need to incorporate three important characteristics, namely (1) "Best Practice" (2), Business Process Reengineering, and (3) Mandatory use.

2.4.1. "Best Practice"

Best practice can be described as the most efficient and effective way of accomplishing a task. The term "Best Practice" is widely used in the business and information systems literature (Foorthuis & Brinkkemper, 2008; E. Wagner, Scott, & Galliers, 2006), resulting in numerous definitions being proposed. For example, Best practice has been defined as

- "techniques, methods, processes, activities, or other actions in conducting business that are most effective at delivering a particular outcome." (APICS., 2002b)
- any habit, knowledge, know-how or experience that has proven to be valuable or effective within one organisation, and may have applicability in other organisations (O'Dell & Grayson, 1998)

Rather than reinventing the wheel, or reliving others' mistakes, the identification and adoption of Best Practice allows organisations to exploit existing tried and test mechanisms for conducting business (Gratton & Ghoshal, 2005; E. Wagner et al., 2006). In this way, Best Practices help to attain significant cost reductions, streamline operational processes, retain customers and increase employee productivity ((Siguaw & Enz, 1999). Thus, for organisations striving to stay in business and to remain competitive, the adoption of Best Practices is considered to be of strategic importance (O'Dell & Grayson, 1998).

The notion of "Best Practice" is central to the value proposition of ERP systems (E. Wagner et al., 2006). ERP systems are embedded with a specific business model for a particular industry, which is based on "Best Practice" (for example Markus et al., 2000; Martinsons, 2004; Sia & Soh, 2007; Soh, Sia, & Tay-Yap, 2000). This model essentially specifies the steps that should be followed in order for each transaction to be effectively and efficiently executed within the context of that industry (Kallinikos, 2004). "Best Practice" is defined by the developers' view of the best way to carry out business processes (Foorthuis & Brinkkemper, 2008; O'Dell & Grayson, 1998).

Kallinikos (2004) provides the following example of such a model:

> "The SAP/R3 "Materials management" module comprises the following criteria for evaluating suppliers: price, quality, delivery, general service and external service. The information about the suppliers recorded in the database is structured along these dimensions and the system provides, in addition, information about the past performance of suppliers. This way the system stipulates the steps through which the evaluation of suppliers (a subtask within the wider task of choosing and placing an order) must take place."

These "Best Practice" processes are built into an ERP system through the functionality provided in the system. Thus, ERP systems are more than just a software package – they dictate the way in which people perform their tasks, by supporting some actions whilst restricting other actions. Through "Best Practice", ERP systems are designed to standardize the way in which tasks and processes are carried out throughout the organisation, and in this way shape human agency at work (Howcroft, Wagner, & Newell, 2004; Kallinikos, 2004; E Wagner & Newell, 2004).

However, a great deal of criticism has been levelled against the notion of Best Practice, both within the business and information systems environments. These are described next.

2.4.1.1. Competitive vs Comparative Advantage

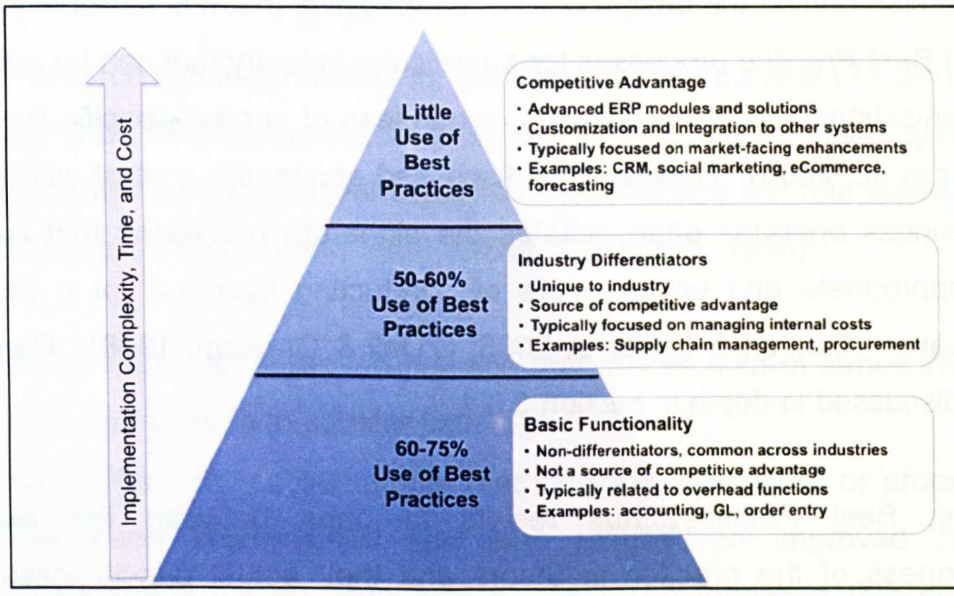
Vendors claim that the Best Practices embedded within their systems enable competitive advantage because the system supports tried and tested business processes at the industry level. Further, some researchers have suggested that successful implementation of ERP systems should lead to competitive advantage as a result of reduced costs and improved productivity (for example

Savage, Callaghan, Dang, & Sun, 2010). However, other researchers have argued that adopting Best Practice processes allows a company to achieve a comparative, rather than competitive advantage: ERP systems are essentially a "standardizing approach" (Galliers & Newell, 2001, p.610), promoting the use of a business model that is a common solution to other organisations in the same industry or beyond. If companies within the same industry are conducting business in the same way, by following the same business processes and models, there can be no competitive advantage (Davenport, 1998; Galliers & Newell, 2001; Markus & Tanis, 2000; Timbrell, Andrews, & Gable, 2001). Adopting Best Practice therefore provides an organisation with the same processes as its competitors, thus allowing it to conduct business in the same way. Therefore, adopting Best Practice should be seen as a way of bettering an organisation's comparative position relative to its competitors, rather than as a means of attaining competitive advantage (Davenport, 1998; Galliers & Newell, 2001)

In contrast to Best Practice, competitive advantage is gained through signature processes (Davenport, 1998; Gratton & Ghoshal, 2005; Hong & Kim, 2002). Signature processes refer to the processes that have evolved internally "from the passions and interests within the company" (Gratton & Ghoshal, 2005, p.49), they reflect a company's unique ways of conducting business, and are usually so idiosyncratic that other companies would find it hard to replicate them. Signature processes are often in conflict with Best Practice – adoption of the latter often results in losing the former. Therefore, it has been suggested that combining signature processes with Best Practice is the most effective way of enabling a company to prosper and compete (Gratton & Ghoshal, 2005; Kimberling, 2010).

Each type of business process within an organisation may require different ratios of Best Practice to signature processes: (Kimberling, 2010) presents one example as illustrated in Figure 4.

Figure 6: Best Practice : Signature Process Ratio Example
(Source: (Kimberling, 2010))



In this example, three layers of functionality have been identified, namely overhead functions (basic functionality), internally-facing processes (industry differentiators) and customer-facing processes (competitive advantage). Kimberling suggests that overhead functions such as accounting, general ledger and order entry functions could make use of between 60 – 75% of industry Best Practice, with signature processes making up the remaining portion to meet the specific needs of the organisation. Internally-facing processes are identified as unique to the industry and typically focused on managing operational costs. Not all companies within a particular industry require all of these processes, and therefore Best Practice should make up only between 50 – 60% of these processes. Customer-facing processes, such as Customer Relationship Management, e-Marketing and Social Marketing, are the processes that provide a company's unique competitive advantage, and therefore Best Practice should play little part in these processes.

The impact of adopting Best Practice on various aspects of the organisation has been identified as a critical success factor for ERP implementation, which is discussed in section 2.5. The impact of Best Practice on existing work practices within an organisation is a critical theme underlying this research and is discussed in depth throughout the remainder of this thesis.

2.4.1.2. Context-specific

The premise behind the design of ERP packages is that it is possible to define a set of Best Practice processes for a particular industry that can be applied to all organisations within that industry, regardless of context-specific issues (E. Wagner et al., 2006). However, as discussed above, the context within which the business operates often dictates the signature processes that form the most appropriate and unique ways of conducting business for a particular organisation (Gratton & Ghoshal, 2005; O'Dell & Grayson, 1998). Context of use is discussed in depth in section 3.3.1.

Adopting Best Practice thus results in gaps between the expected effectiveness of the practice in theory and their actual effectiveness when implemented in practice (Green, 2001). These gaps are referred to in the literature as Package-Organisation Misfits (Sia & Soh, 2007), or feature-function misfits (Markus & Tanis, 2000) and are discussed in more detail in section 3.2.2. Therefore, although Best Practice may have been tested in many different situations, this should not be adopted blindly, but should rather be seen as a guideline (E Wagner & Newell, 2004).

For this reason, implementation of ERP systems and their embedded Best Practices require adaptation of their embedded practices for the target organisations (Green, 2001). Adaptation methods are discussed in depth in section 4.2.

2.4.1.3. Levels of Best Practice

Questions have arisen regarding the validity of the Best Practices identified by vendors and embedded into industry-specific ERP systems. As Wagner & Newell (2004) observe, industry Best Practices are typically the result of a partnership between a software development company and a key industry customer, the objective of which is to develop a software system that meets the specific requirements of a particular industry. This suggests that these Best Practices may not have been developed as a result of a thorough investigative process, but rather have been created by a relatively small, but powerful, interest group (Foorthuis & Brinkkemper, 2008). In cases such as these, it would not be appropriate to label the resultant practices as Best Practice.

In their research into the methods for identification and transfer of internal Best Practices, O'Dell & Grayson (1998) identified a categorisation used by one of their respondent companies that classified Best Practice into four levels. These are (Foorthuis & Brinkkemper, 2008; O'Dell & Grayson, 1998):

- Good idea – an unproven practice that makes a lot of sense intuitively, but requires data to substantiate it.
- Good Practice – a technique, methodology, procedure or process that has been implemented and has resulted in improved business performance for an organisation. Data substantiating this claim has been collected at the location at which the practice has been implemented. Little or no comparative data have been collected regarding the effectiveness of the practice in other organisations.
- Local Best Practice – a good practice that has been determined to be the best approach for all or part of an organisation. This is based on an analysis of performance data, including the performance of similar processes outside of the originating organisation.
- Industry Best Practice – a practice that has been determined to be the best approach for all or most of the organisations within an industry. This is based on benchmarking within and external to the originating organisation, and includes analyses of performance data, including the performance of similar processes in organisations outside of the industry.

Given the continued difficulties being experienced with Best Practice in terms of context specificity and loss of comparative advantage, it may be better for ERP vendors to refer to the embedded practices as good practices, or local Best Practices, rather than industry Best Practices.

2.4.2. Business Process Reengineering

A business process is “a set of logically related tasks or activities performed to achieve a particular business outcome.(Savage et al., 2010, p.5). For example, the business outcome of the order entry process is a customer order. Traditionally, organisations were structured in terms of functional departments, and information systems were developed to support the business processes of a single functional area, for example, accounting or human resources.

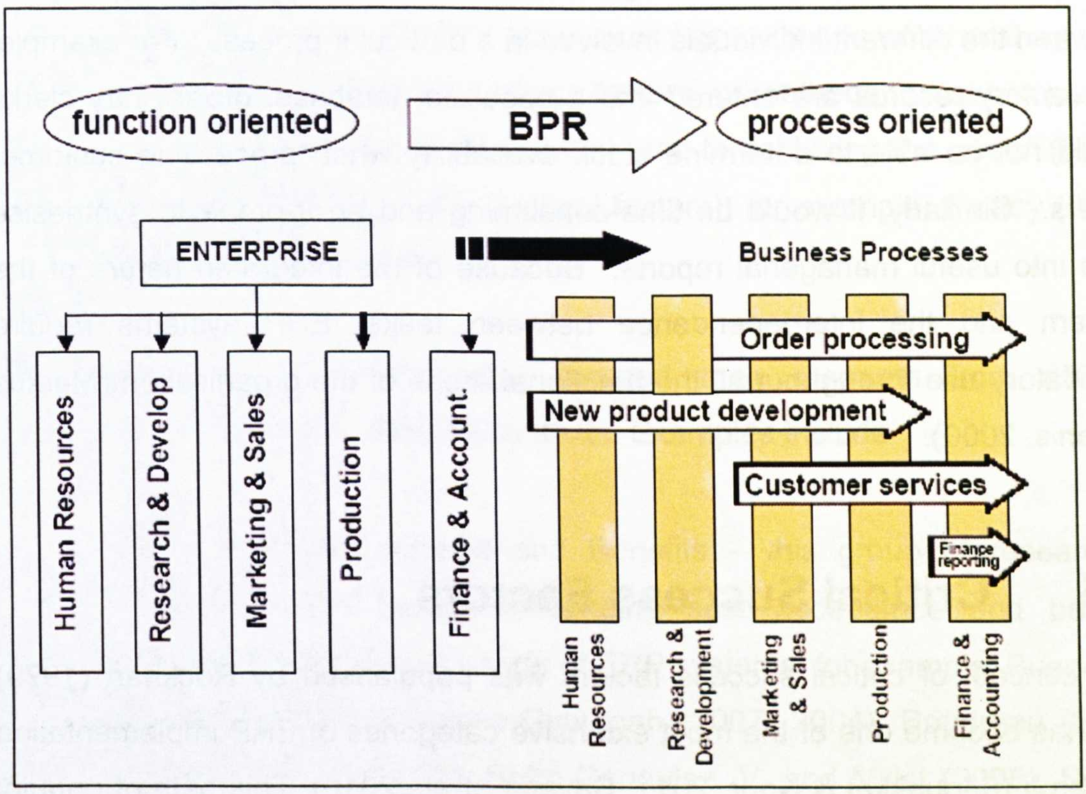
The concept of business process reengineering (BPR) was initiated by Hammer and Champy (1993) in an attempt to help organisations reconsider the way in which they conduct business to obtain dramatic improvements in customer service and administrative costs. BPR proposed that, rather than considering the individual tasks that each functional area performs, complete processes should be considered. Thus, for example, rather than viewing the receipt of a customer order, the acquisition of materials, the production of the goods, and the delivery of the goods to the customer as separate tasks or processes, these tasks should be consolidated into the single business process of order processing.

ERP systems are developed on the basis of this process-oriented view, in contrast to traditional software which is function-oriented. Implementing an ERP system requires not only that business processes are reengineered to match the processes embedded within the system (H. Klaus et al., 2000), but also that the organisation itself is reengineered to reflect a process-oriented structure (Robey et al., 2002). Thus, the business model provided by "Best Practice" influences the organisational structure in terms of operating hierarchies, standard operating procedures, and rules that the organisation needs to follow when utilising the ERP system (Soh et al., 2000). In order to realise the benefits of the generic Best Practice business processes embedded within the system. “BPR followed by ERP” (Koch, 2002, p.261) is necessary for successful ERP implementation (Gattiker & Goodhue, 2004; Savage et al., 2010).

This process-oriented structure results in users from various functional departments having to work together on a single business process. For example, as Figure 7 illustrates, order processing would incorporate users from Human Resources, Marketing and Sales, Production and Finance & Accounting.

Figure 7: Process and Functional Views of Organisations

(Source: Keller et al, 1995, p2, in (Skok & Legge, 2002))



The transition from a function-oriented to a process-oriented organisational structure has a substantial impact on employees. Like the adoption of Best Practice, moving from a function-oriented structure to a process-oriented structure can significantly affect the existing work practices of employees, causing significant resistance to the implementation of the technology that brought about the change (Hirscheim & Newman, 1988; H. Klaus et al., 2000; Sheth, Sisodia, & Sharma, 2000; Szulanski, 2003). Resistance to the acquisition of new business processes is discussed in detail in section 4.3. In addition, some of the existing business processes may be unique and may underlie the organisation's competitive advantage over their competitors.

In these cases the ERP software would need to be customised to avoid losing this advantage through redesigning these processes (Davenport, 1998; Savage et al., 2010). As noted above, customisation is discussed in section 4.2.

2.4.3. Mandatory Use

The process-oriented view of organisations results in an interdependence between the different individuals involved in a particular process. For example, if inventory records are entered into a separate database, order entry clerks would not be able to determine stock availability when processing customer orders. Similarly, it would be time-consuming and error-prone to synthesise data into useful managerial reports. Because of the integrated nature of the system and the interdependence between tasks, ERP systems require mandatory use throughout all the functional areas of the organisation (Markus & Tanis, 2000).

2.5. Critical Success Factors

The concept of critical success factors was popularised by Rockhart (1979) and has become one of the most extensive categories of ERP implementation research ((Mouakket & Nour, 2011; Savage et al., 2010). This path of enquiry has identified numerous factors that can be considered to be critical to the success of ERP implementations.

The success factors proposed in the literature cover a wide range of issues that have been grouped into many different categories (Mouakket & Nour, 2011). However, consensus in terms of a single method of classification has not yet been reached (Esteves & Bohorquez, 2007; Finney & Corbett, 2007; Mouakket & Nour, 2011)). The following are examples of categorisation frameworks that have been proposed in the literature to date:

- Life Cycle – critical success factors are grouped according to the phases of the ERP life cycle to which they are applicable, for example, Nah et al (2006; 2001); Somers and Nielson (2004). Section 2.2.5

reviews the various ERP life cycles that have been proposed in the literature.

- Stakeholder – factors are grouped according to the perspectives of key stakeholder groups, for example, Mouakket (2011); Chang et al., (2008); Skok and Legge, (2001) Sedera et al, (2004b). The impact of diverse stakeholder groups on measuring ERP success is discussed in section 3.2.3.
- Strategic/Tactical – factors are grouped according to whether they relate to organisational goals (strategic factors) or methods for "accomplishing the various strategic elements that lead to achieving the goals" (Finney & Corbett, 2007, p. 335) (tactical factors), for example, Finney (2008); Holland & Light, (1999),

In addition, some studies have focused their research from different perspectives and within different contexts. Examples include

- User Satisfaction, Usage and Benefits – this group of researchers focuses on the factors influencing user acceptance and benefits realisation derived from usage of ERP systems, for example, Bueno and Salmeron (2008); Amoako-Gyampah (2007; 2004); Boudreau (2002), Kositanurit et al. (2006), Botta-Genoulaz, V. and Millet (2005), Sedera and Tan (2005). Usage and benefits realisation are discussed in detail in chapter 3.
- Misalignments – this is a subset of the usage context which focuses on the factors causing misalignments between ERP features and organisational requirements, for example Sun et al, (2009); Sia and Soh (2007); Soh et al (2000), Soh and Sia (2004); Kang et al, (2008). As noted above, misalignments form the underlying premise of this research, and are therefore discussed in detail in section 3.3.2.
- Knowledge management – these studies focus on the factors relevant to the successful transfer of knowledge during the implementation of an ERP system, for example, Xu & Ma (2008) , Ko et al, (2005), Timbrell (2001), Park et al (2007) , Sedera et al, (2003; 2004a); Chan and

Rosemann, (2001; 2001). These factors, or barriers to the knowledge transfer process, are reviewed in section 4.3.2.

- Country Specific – this topic refers to studies that focus on examining ERP implementation success factors within a particular country context. For example, critical success factors affecting ERP implementations in Poland (Soja, 2006); China (Woo, 2007; Zhang, Lee, Huang, Zhang, & Huang, 2005); Venezuela (Colmenares, 2004), and Malaysia (Subramaniam & Venkatraman, 2001).
- Sector Specific – numerous studies have focused on success factors for ERP implementation in universities, for example, Dyke and Sinclair (2003); Bradley and Lee (2004). Critical success factors within the health sector has also been widely researched, for example, Tulu et al., (2006) and Chau and Hu, (2001)

Despite the differences in categorisation, however, lists of the top 10 critical success factors appear to be relatively consistent in content across studies, contexts and time periods, although the ranking of each factor tends to change (Huang, 2010; Savage et al., 2010),

Table 4: Comparison of Top 10 Critical Success Factors

Rank	Top 10 Critical Success Factors			
	Ganesh (2010) (survey research)	Dezdar & Sulaiman (2009) (Frequency analysis)	Finney (2007) (Frequency analysis)	Somers & Nelson (T.M. Somers & Nelson, 2001) (survey research)
1	Business Plan, Vision	Top management support and commitment	Top Management Commitment and Support	Top management support
2	Top Management Commitment and Support	Project management and evaluation	Change management	Project team competence
3	Project Champion	Business process reengineering and minimum customization	BPR and minimum customisation	Interdepartmental cooperation
4	Focused Performance Measure	ERP team composition, competence and compensation	User training, education and redesign	Clear goals and objectives
5	Change Management Process	Change management programme	ERP team composition, competence and compensation	Project management

Rank	Top 10 Critical Success Factors			
6	Effective Communication Plan	User training and education	Project management and evaluation	Interdepartmental communication
7	Risk Management	Business plan and vision	Consultant selection and relationship	Management of expectations
8	Post Implementation Evolution	Enterprise-wide communication and cooperation	Business plan and vision	Project champion
9	BPR and Software Configuration	Organisational culture	Project champion	Vendor support
10	Quality Improvement Measures	Vendor support	Communication plan	Careful package selection

As reflected in Table 4, for example, "Top Management Support" dropped to second place in 2010 after holding first place 2001. Similarly, "Change Management", which did not appear on the 2001 list, was ranked second in 2007, and dropped to fifth place in 2009, where it remained in 2010.

The above discussion reflects that critical success factors have been extensively studied (Esteves & Bohorquez, 2007). These factors have been identified and tested in different contexts, including different organisations, countries, technological maturity environments, industry sectors and stakeholder groups, by many different researchers (Ganesh & Mehta, 2010). Whilst the top 10 factors listed in Table 4 reflect the key critical success factors, other factors have also been identified and tested; these include (but are not limited to) architecture choices, legacy system considerations, data analysis and conversion, usability, employee attitude and morale, ease of maintenance, vendor service and reputation, and risk management (Dezdar & Sulaiman, 2009; Finney & Corbett, 2007; Ganesh & Mehta, 2010; Mouakket & Nour, 2011).

However, despite the abundance of critical success factors in the literature, almost 75% of adopting companies are still reporting that their ERP implementation initiatives have fallen short of their expectations, with negative outcomes including problems of data inaccuracies, resistance by users, customer frustration, high staff turnover and ultimately a loss in profits

(Kimberling, 2011; Mouakket & Nour, 2011; Savage et al., 2010). ERP implementation failures and their cost are discussed in the following section.

The reasons for this continued high failure rate may be due to two specific gaps that have been noted in the critical success factor literature. These are as follows:

(1) Authors tend to focus on a single category of factors rather than integrating many categories into their research model (Huang, 2010). This research addresses this gap by incorporating the following categories of success factors into a single research model: user satisfaction, usage and benefits, knowledge transfer, and misalignments. The research model is presented in Chapter 5.

(2) Whilst misalignments from the perspective of organisational processes and structures have been investigated, the potential for misalignments arising as a result of occupational influences has not. The impact of occupational strength of commitment on ERP success is discussed in section 4.4 and is included as an independent variable in this study's research model.

2.6. The Rates and Cost of Failure

The high failure rates experienced in implementing ERP systems have been widely cited in both the academic and industry literature. As Kanaracus (2010) notes "No year in the IT industry would be complete without a number of high-profile ERP project failures". Table 5 lists the top ERP and related software failures for 2010 and 2011.

Table 5: Top ERP Failures for 2011 and 2010

Top ERP Failures reported in 2010 and 2011 (Kanaracus, 2010, 2011)	
NHS UK	A £12 billion project to provide electronic health records for all UK citizens is cancelled by the NHS.
Ingram Micro	The ERP implementation causes a loss in profits amounting to US$14 million in the first quarter and US$8 million in the second quarter.
Montclair State University	The university files a lawsuit against the vendor, claiming that it will cost more than US$20 million to finish the project due to vendor error
ParknPool	The company files a lawsuit against the vendor because the ERP system is the cause of the company making a loss that year.
Whaley Foodservice Repairs	The company sues the vendor for a system that has never worked as it was supposed to, not completing the project on time and for costing more than five times than originally expected.
New York CityTime	Original budgeted at US$60 million, more than US$700 million is spent. The vendor has put aside a US$200 million loss provision in preparation for the impending lawsuit
BSkyB	Original budget of US$48 million, costs quadruple. The company was awarded US$318 million in damages from the vendor
Marin County	The institution replaces a newly implemented system at a cost of $26 million dollars, a cheaper option than the anticipated US$34 million required to address the problems and keep the existing system
Waste Management	The client company sues the vendor for the US$100 million that was spent on the implementation of the system, and another US$350 million for benefits that it would have gained if the software had worked as intended.
Sunshine Mills	US$61 million in damages is awarded to the company because the vendor had provided a beta version of the software which had limited functionality.
Fort Worth Police Payroll	The newly implemented payroll system is not working as intended, incorrectly calculating paychecks in some instances, and not issuing payment at all in other instances.

Although the costs reported in Table 5 are considerable, it has been argued that they may not reflect the true cost of a failed ERP implementation initiative. As Sessions (2009) observes, the cost of a failed project incurs both direct costs and indirect costs. As an example of these different costs, Session quotes the case of the failed United States Internal Revenue Service electronic fraud detection system. Before the project was abandoned in 2006, $185 million dollars had been spent in the 11 preceding years trying to complete implementation. This refers to the direct costs of the project: the investment in the software itself. However, an additional $894 million was reported to have been lost in fraudulent tax refunds during 2006, and presumably this would continue until an appropriate system is implemented. Thus, the indirect cost of failure should take into account the costs of replacing the failed system, business downtime and disruptions, lost revenue, lost opportunity on what that lost revenue could have been used for, lost market share (Sessions, 2009), and of course, legal fees.

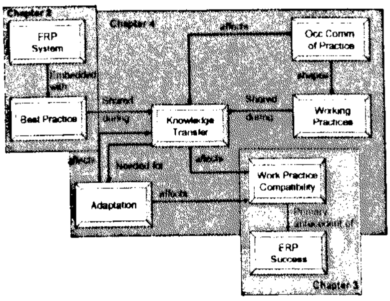
The magnitude of the cost of ERP failures thus suggests that "as IT professionals we have a responsibility to understand how we can prevent the continuing spiral of failures that is burying us" (Sessions, 2009).

2.7. Summary

The decision to adopt ERP systems is primarily influenced by the expectation that such adoption will result in increased organisational performance. In order to achieve these benefits, ERP systems are embedded with a "Best Practices" business model which encapsulates a specific business process model, thus often requiring substantial business process reengineering and always requiring mandatory use across the organisation. ERP systems are therefore considered to be socio-technical systems that influence and are influenced by human agency at work (Kallinikos, 2004; C. J. Stefanou, 2002), with adoption resulting in significant impacts on the organisation at the individual, work group, organisational and inter-organisational levels (Markus & Tanis, 2000).

Numerous critical success factors for ERP implementations have been identified. Although no common categorisation method has been identified, the top 10 factors identified by various researchers appear to be relatively similar. However, high failure rates continue to be reported by adopting organisations, with substantial costs attached.

One possible reason for this continued failure rate discussed in this chapter is the Best Practice characteristic of ERP systems. Because the Best Practice processes are generic in nature, misfits between the organisational requirements and the system's functionality occur, resulting in many organisations finding that there are important needs that are not met by the system. This issue, together with the concept of ERP success, is the subject matter of the next chapter.



CHAPTER 3

SYSTEM SUCCESS

"I am a Bear of Very Little Brain, and long words Bother me."

Winnie the Pooh - *Winnie the Pooh*

3.1. Introduction

The importance of ERP systems as mission-critical systems was established in the previous chapter. This chapter addresses the concept of ERP success.

The chapter begins with a review of the broader definitions and theories of Information Systems success (3.2). The difficulties of measuring success are reviewed, in terms of the measures and proxies used, when to measure success, and at what level to measure it. Attention is then turned to the concept of user needs (3.3). Drawing from the usability and fit literature, it is demonstrated that IS success, and in particular, ERP success, is dependent on the system meeting the implied and stated needs of the users. The chapter concludes with a discussion of the concept of Work Practice Compatibility (3.4), which, it is argued, is a critical factor for achieving the needs of the users.

3.2. Success

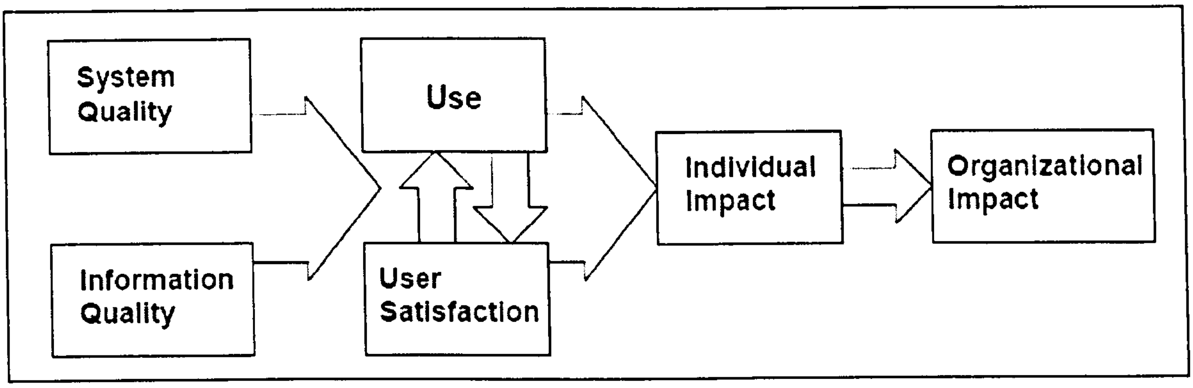
Information system success is a contentious issue that has been at the centre of a great deal of debate in the academic and industry literature (for example DeLone & McLean, 1992, 2003; Rai, Lang, & Welker, 2002; Seddon, 1997; Seddon, Staples, Patnayakuni, & Bowtell, 1999). Most ERP system success models draw from the more general IS success models, which has resulted in both the agreements and disputes surrounding the IS models to be mirrored in the ERP success models. The problem with measuring IS and ERP success is that it is an ambiguous concept that can be measured at different levels and at different times during the system life cycle (DeLone & McLean, 2003; Rai et al., 2002; Robey et al., 2002). These difficulties are discussed in detail below.

3.2.1. Information Systems Success

In 1992, DeLone and McLean proposed a model of information systems success that was intended to bring 'awareness and structure to the "dependent variable" – IS success – in IS research' (DeLone & McLean, 1992, p.10). Drawing from the theory of communication proposed by Shannon & Weaver (1949), and its subsequent adaptation for the measurement of information systems by Mason (1978), the DeLone and McLean model (hereafter referred to as the D&M model) identified six categories of IS success. The model is illustrated in Figure 8 and the components are defined as follows.

- **System Quality**: The desirable characteristics of the system itself, for example, reliability and ease of use
- **Information Quality**: The desirable characteristics of the information that the system produces, for example, accuracy and timeliness
- **Information Use**: The extent to which the information from the system is used, for example, the frequency and number of system functions and/or reports used. which also indicate the voluntariness of use
- **User Information Satisfaction**: The positive or negative response of the user to the use of the information produced by the system, for example, the type and quantity of information received.
- **Impact on Individual**: The effect that the information from the system has on the user's work behaviour (performance), for example, time to complete a task and effectiveness of decisions made.
- **Impact on Organisation**: The overall effect of the information from the system on organisational performance, for example, profitability, productivity and overall organisational effectiveness

Figure 8: DeLone & McLean's (1992) Information Systems Success Model



The D&M model incorporates both a process and a causal view of information systems success. From a process perspective, the model reflects that information system success can be viewed in terms of the following steps:

(1) An information system, containing features and functions, is created or purchased. These features and functions display varying degrees of system and information quality.

(2) Users use the system's functions and features.

(3) Users are either satisfied or dissatisfied with the system.

(4) The use of the system impacts on individual users' work performance.

(5) Organisational impacts are determined by the sum of the individual impacts.

From a causal perspective, the model illustrates that IS success consists of six dimensions, and that there is a causal relationship between these dimensions. The model reflects that

- Higher information / system quality is expected to increase user satisfaction and use
- Increased user satisfaction results in increased use, and increased use results in increased user satisfaction
- Increased user satisfaction and use lead to positive impacts for individuals
- Positive individual impacts result in positive organisational impacts

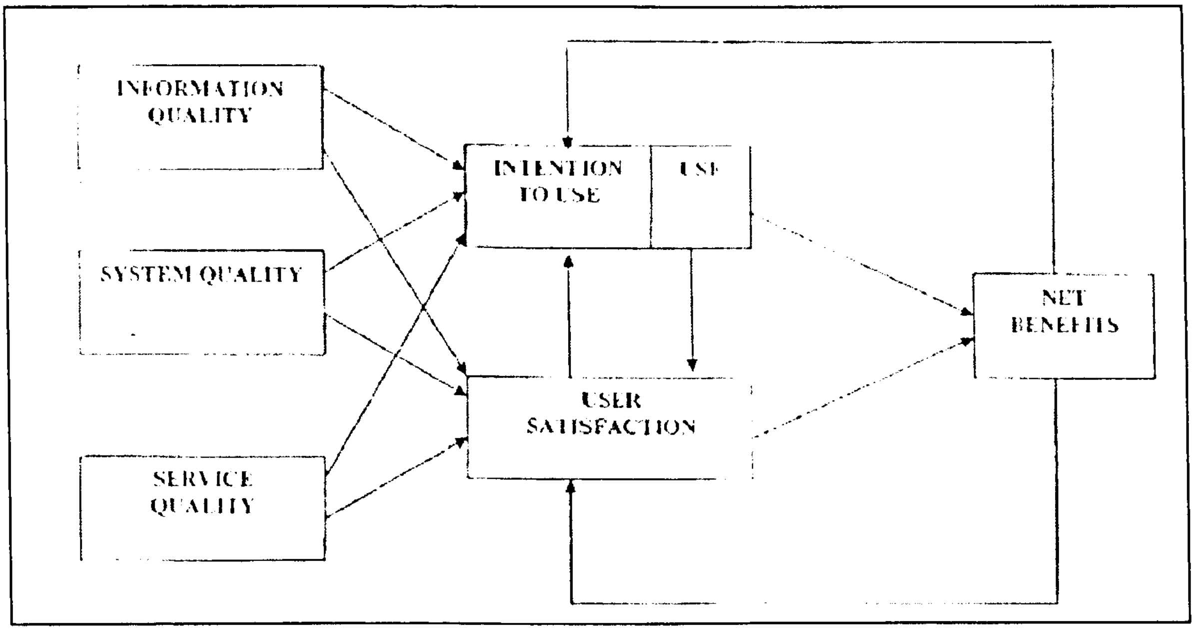
The D&M model was widely adopted by the IS research community in the decade following its publication, with more than 300 studies applying, developing, challenging or validating the model. These studies contributed two criticisms of the model that are relevant to this research, namely (1) the appropriateness of individual and organisational impacts as the dependent variable; and (2) appropriate measures of benefits. These are discussed below.

3.2.1.1. Appropriateness of Impacts

From a process perspective, the D&M model advocates that the use of the system generates impacts on individuals' work performance. As organisational impacts are the sum of individual impacts, D&M's model suggests that it is these impacts - the consequences of use – that reflect the success of the system. Seddon et al (1999) challenged this contention, arguing that due to different stakeholder perspectives and goals (see 3.2.3), the consequences of system use could be perceived as positive or negative; different stakeholders may have different opinions as to what constitutes a benefit to them (Seddon et al., 1999). Further, they argue that the critical issue relating to IS success is not that the system is used, but that benefits flow from their use. Consequently, success should ideally be measured in terms of Net Benefits, that is, the sum of all benefits less all the costs attributable to the use of the system. This view is supported by Markus & Tanis (2000), who note that it is important to consider the reasons for ERP adoption when assessing the success of the system.

The original D&M model was revised in 2003, and is depicted in Figure 9. It reflects D&M's consensus on this issue in that Individual Impact and Organisational Impact were replaced by the single dependent variable of Net Benefits. D&M also pointed out that the number of entities that are impacted by an IS have expanded – for ERP in particular, this can include the entire supply chain, that is, customers, suppliers and external stakeholders. Rather than complicating the dependent variable further by adding categories to accommodate for all these different entities, they decided to consolidate the entities into the single category of Net Benefits, thus leaving the researcher to identify which entities and related measures are appropriate for each study.

Figure 9: DeLone & McLean's (2003) Updated Success Model



Other aspects of the D&M model have also been criticised and changes proposed. For example, Seddon (1997) suggests that Use is a consequence of Success, rather than the other way around. These issues, while important for the broader understanding of IS success, fall outside the scope of this study and are not explored further here.

Problems associated with the Net Benefits approach are discussed in the following section. Nevertheless, the research community appears to have reached a consensus that information system success should be measured in terms of the net benefits accruing from the use of the systems. This view is mirrored in the more recent ERP success models (for example, Chang et al., 2008; Wu & Wang, 2007) and is consequently adopted for the purposes of this research study.

3.2.1.2. Measuring Net Benefits

To adequately incorporate the diversity of impacts, IS and ERP benefit measures should not be limited to financial benefits, but should include non-financial benefits (Gable et al., 2003), such as those derived from business process improvement and increased capacity (Shanks & Seddon, 2000), as well as the measures included in the balanced scorecard approach which contain such measures as staff requirements reduction and cost reduction (D. Sedera, Gable, & Rosemann, 2001).

Many of these costs and benefits are either unquantifiable or cannot be isolated from factors other than the system (Holsapple, Wang, & Wu, 2005). Measuring net benefits is therefore a difficult and cumbersome process that cannot be done with precision and could therefore provide unreliable results (Seddon, 1997). Consequently, prior research has advocated that proxies should be used as the dependent variable for IS and ERP success (Rai et al., 2002).

The two surrogate measures for Net Benefits most widely proposed in the literature are User Satisfaction and System Usage (Boudreau, 2002; Markus & Tanis, 2000; Seddon, 1997; Seddon et al., 1999). Although substantial arguments have been put forward both in favour and in opposition, it is contended here that neither are appropriate for measuring Net Benefits within the ERP context, and that Quality in Use should be used instead. The reasons for this view are outlined below.

System Usage

There is no single accepted definition of system usage, resulting in the construct having been conceptualised and operationalised through diverse and often conflicting measures (Burton-Jones & Straub, 2006; Jeyaraj, Rottman, & Lacity, 2006). Such conceptualisations can be categorised into the three dimensions of time, reliance and diversity (Boudreau, 2002). Drawing on the reviews provided by Boudreau (2002), Burton Jones and Straub (2006), Jeyaraj (2006) and Trice (1988), the different measures that have been used in prior research are categorised according to Boudreau's classification. This is reflected in Table 6.

Table 6: Classification and Measures of System Usage in Prior Research

Dimension	Explanation	Examples of Measures
Time	Amount of time spent using the system	▪ Number of functions used ▪ Number of times system is used in a particular period ▪ Number of hours spent using system
Reliance	Extent to which users depend on the system to perform their work	▪ Percentage of time system is used to perform task ▪ Degree of dependence on system to perform tasks ▪ Voluntary vs mandatory use ▪ Decision to use
Diversity	The different ways in which the system is used	▪ Number of tasks supported by system ▪ Number of system features used ▪ Direct or indirect use

Those in favour of the system usage approach to measuring success argue that Use is a reflection of the acceptance of the technology (Amoako-Gyampah, 2007; Sabherwal, Jeyaraj, & Chowa, 2006). This may be true for discretionary-use systems, such as Web Sites or spreadsheet applications. However, when system use is mandatory, as in the case of ERP systems, users have no option but to use the system if they want to keep their jobs (S. A. Brown, Massey, Montoya-Weiss, & Burkman, 2002). Moreover, high levels of use could indicate a negative impact on performance rather than a benefit. For example, the system could be causing the users to spend more time in completing a task than previously. Whilst this would reflect high system usage, such use would actually result in reduced performance (Goodhue, 1998; A. W. Trice & Treacy, 1988). In addition, ERP systems are complex systems that include a diversity of features for generic use. This suggests that a proportion of the features embedded in the system may not be relevant to the specific users within a particular organisational context, and therefore the number of system features actually used cannot be an accurate reflection of the level of use of the system. Thus, measuring success in terms of any of the system use measures reflected in Table 6 is inappropriate in the context of ERP domain (N.. Bevan, 1995; N. Bevan & MacLeod, 1994; Boudreau, 2002).

Thirdly, and most importantly, it has been shown (in Section 3.2.1.1) that the critical issue for success is not whether the system is used, but rather that benefits should arise from such use (DeLone & McLean, 2003; Markus & Tanis, 2000; Seddon, 1997). Use does not necessarily produce benefits: use generates impacts, and impacts can be perceived as positive or negative, depending on which stakeholder's viewpoint is being adopted.

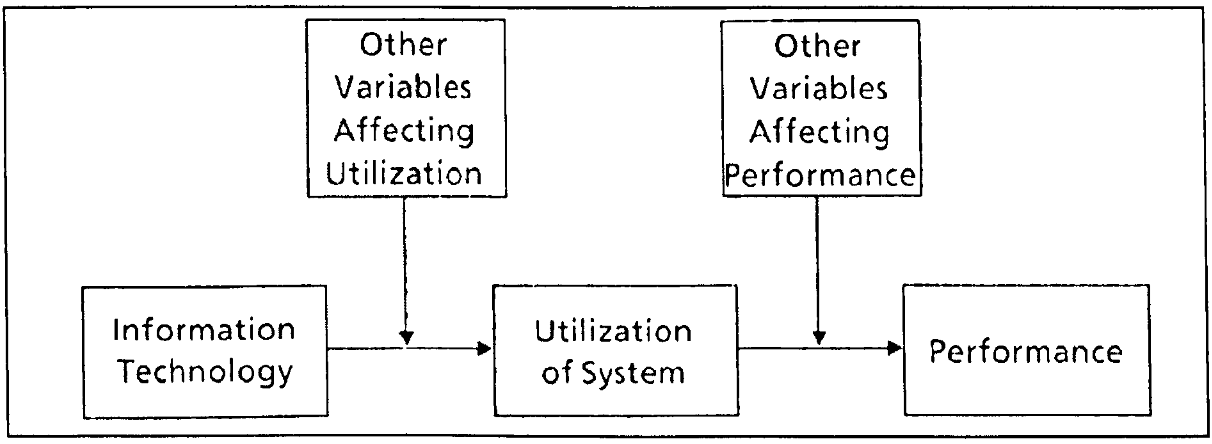
Boudreau's (2002) case study results provide empirical support for this view. Her study investigated the use of an ERP system in a government organisation. The findings reflected that users spent many hours using the system, they depended on the system to be able to perform their work, and they made use of a diversity of system features. Thus, in terms of the dimensions of time, reliance and diversity, it would appear that the system was successful. However, even after the system had been in operation for more than a year, the system was not being used to its full potential, users were struggling to understand how the system worked and which functions were appropriate to them, and were incorporating workarounds to meet their work requirements. In other words, whilst use was high, quality in use was limited.

User Satisfaction

A similar argument leads to the rejection of the User Satisfaction approach to measuring benefits. User satisfaction is defined in other parts of the literature more broadly than the definition used by Delone & McLean as the sum of one's feelings regarding an information system (Bailey & Pearson, 1983; Doll & Torkzadeh, 1988; Ives, Olson, & Baroudi, 1983). It has been shown that the higher the user satisfaction, the more likely the system will be used (Holsapple et al., 2005; T.M. Somers et al., 2003; Wixom & Todd, 2005). However, a conceptual link between user satisfaction and performance (benefits) has not been clearly established (Goodhue, 1995; Wixom & Todd, 2005). User satisfaction is a subjective measure, and has been shown to be an unreliable indicator of performance. Therefore, whilst increased user satisfaction increases usage, there is no evidence that increased user satisfaction enhances the quality in use that is required to achieve benefits from use.

These issues lead to the conclusion that neither system use nor user satisfaction is an appropriate proxy for system success. From a causal perspective, a positive use experience will result in heightened satisfaction which in turn leads to increased actual usage (DeLone & McLean, 2003). From a process perspective, use must precede both user satisfaction and performance impacts. Consequently, as illustrated in Figure 10, user satisfaction and usage are considered to be intervening variables between information systems and performance, rather than appropriate proxies for measuring success.

Figure 10: System Use as an intervening variable
(Source: (A. W. Trice & Treacy, 1988, p.39))



As DeLone and McLean (2003) argue: "Without system use, there can be no consequences or benefits. However, with system use, even extensive use, that is inappropriate or ill-informed, there may also be no benefits" (p.16). Therefore, whilst system use must necessarily precede benefits realisation (from a process perspective), it is the quality of such use (N.. Bevan, 1995; Boudreau, 2002) that influences the degree to which benefits are achieved.

3.2.2. Measuring Success - Quality in Use

Numerous models have been developed for measuring success. These include the Theory of Reasoned Action (TRA, (Ajzen & Fishbein, 1980), the Theory of Planned Behaviour (TPB, (Ajzen, 1991), the Technology Acceptance Model (TAM, (Davis, 1989)), the Unified Theory of Acceptance and Use of Technology (UTAUT, (Venkatesh, Morris, Davis, & Davis, 2003)), and the Diffusion Theory (IDT, (Rogers, 1983)). Of these models, TAM is the most widely accepted (Srite, 2006), and the most used framework in prior ERP research (Jeyaraj et al., 2006). However, all of these models were developed as a way of predicting use or user satisfaction, or to explain the factors that influence use in terms of time, diversity and satisfaction. As discussed above, there is no evidence that either system use, or user satisfaction, has any influence on the quality in use that is required for attaining system benefits. Therefore, none of these models are appropriate for investigating quality in use, and consequently, an alternative model or set of metrics is required for measuring ERP success in terms of quality in use.

Boudreau (2002) defines Quality in Use as "the ability one has to correctly exploit the appropriate capabilities of software in the most relevant circumstances" (p. 2). The ISO 9126 provides a more comprehensive definition of Quality in Use as "the extent to which a product used by specified users meets their needs to achieve specified goals with effectiveness, productivity, safety and satisfaction in a specified context of use", (ISO/IEC, 2004, p.4, emphasis added), where

- Effectiveness refers to the extent to which the intended goals of use are achieved with accuracy and completeness in a specified context of use. This can relate to task completion as well as expected benefits (perceived usefulness)
- Productivity refers to the resources that have to be expended to achieve the intended goals within a specified context of use, and include personnel, time and money, and the cognitive effort required by the users (ease of use).

- Safety refers to the extent to which the system provides acceptable levels of risk of harm to people, business, software, or property within a specified context of use. This includes risks associated with lack of functionality, reliability, usability and maintainability
- Satisfaction refers to the extent to which the user finds the use of the product acceptable.
- Context of use comprises the user, the task, the technology and the environment (N. Bevan, 1999).

The stated goal of the 9126 standard is to "achieve the necessary and sufficient quality to meet the real needs of users" (ISO/IEC, 2001, p.4). Combined with the broader definition discussed above, this reveals that quality in use refers to meeting users' needs in terms of their job performance. The benefits that accrue to users as a result of using the product are derived from the system's ability to enhance their task performance, as a result of meeting their job needs. Simply stated, quality in use is about meeting user needs so that they are able to complete their tasks effectively, productively, safely and with satisfaction. This demonstrates that quality in use is more than just knowing which functions to use and when: it relates more broadly to the extent to which the software meets the needs of the users (Affleck & Clark, 2008; N. Bevan & MacLeod, 1994; Dix, Finlay, Abowd, & Beale, 2004). This view is supported by Moore & Benbasat (1991) who note that "an innovation cannot be viewed as advantageous if it does not meet users' needs".

This view is echoed in the measures of quality in use put forward in the ISO 9126-1 standard, as well as in Seddon et al.'s (1999) revised model of IS success. The standard recommends that quality in use be measured in terms of user performance and satisfaction. Or, stated in the reverse: "Measures of user performance and satisfaction assess the quality in use of a product in the particular context of use provided by the rest of the working environment" (N. Bevan, 1997, p.6). The metrics that are proposed refer to the extent to which the users' intended goals of use are achieved, the amount of resources that have to be used to achieve those goals, and the extent to which the users find the use of the product acceptable. Similarly, it has been proposed that job performance and user satisfaction are perceptual measures of the net benefits that accrue as a result of information system use (Rai et al., 2002; Seddon et al., 1999).

Measuring Quality in Use in terms of performance and satisfaction will thus reflect the impact of the software on the users in terms of meeting their job needs. As noted by Kositanurit: "Organisational performance depends on individuals' task accomplishments" (2006, p. 557), suggesting that the net benefits derived from the implementation of ERP or other computer-based systems are dependent on the impacts that the system has on the performance of the employees: better task performance at an individual level will lead to better performance at an organisational level. This view is mirrored in D&M's original (1993) IS model which suggests that success be measured in terms of either individual impacts or organisational impacts, depending on which stakeholder group's views one is adopting when measuring success.

Measuring quality in use in terms of user job performance thus incorporates the need to consider the expected benefits of implementing a new technology (Markus & Tanis, 2000), as well as the level at which these benefits are being measured. Consequently it can be concluded that Quality in Use is an appropriate proxy for system success within the ERP context and the context of this study, as it measures the extent to which the users' needs are being met in terms of the benefits that accrue from system use at the end-user level.

3.2.3. Stakeholder Perspectives and Benefits

ERP systems are used by a diversity of stakeholder groups (see section 2.5), and therefore "success depends on the point of view from which you measure it" (Markus et al., 2000, p.245). Building on previous ERP literature (for example Chang et al., 2008; Chetcuti, 2008). Mouakkett et al (2011) propose the following six stakeholder perspectives (1) End user, (2) Top management, (3) IS Department, (4) ERP project team, (5) Vendor, and (6) Organisation Thus, for example, success can be measured in terms of the adopting organisation's management, its end-users, customers, or the group responsible for the system's implementation.

Different groups of stakeholders may have different goals (Seddon, 1997; D. Sedera et al., 2004b), and therefore an outcome resulting from the adoption of the system can be viewed as successful by one group, but as a failure by another group. For example, from an IS department perspective, it is a well-established tradition that a project that is completed in time, on budget and with the required features and functions is considered to be a success (Nelson, 2006). However, such a project may still be considered to be a failure by top management if it does not result in the expected standardisation and integration of business processes (Davenport, 1998; Markus & Tanis, 2000). Alternatively, such a project may be considered as a failure by end-users who have to learn new ways of working due to the changed business practices resulting from the implementation (Arnold, 2006). There are numerous examples of such "failed successes" in the literature, including the report on a real estate management company's project to develop a Customer Relationship Management application (Nelson, 2006). The project met all the above project specifications, but did not successfully integrate with the company's business processes. This resulted in no one in the organisation using the system.

Consequently, it is necessary to adopt a particular stakeholder group's point of view when measuring success (Markus & Tanis, 2000; Seddon, 1997; D. Sedera et al., 2004b). From the above discussion, it is evident that positive outcomes at a management level may lead to negative outcomes at the end-user level. However, as reflected in D&M's original success model (see 3.2.1), organisational performance is dependent on individual task performance (DeLone & McLean, 1992; Kositanurit et al., 2006). Whilst it is necessary to ensure that ERP systems meet the company's business requirements, it is suggested that it is equally important that the system should meet the users' requirements in terms of effectiveness, productivity, safety and satisfaction (see 3.2.2). The evidence presented in the literature that management may consider the system to be a success whilst the users may not, suggests that the company's business requirements may differ significantly from the users' requirements.

What this suggests is that in contrast to the majority of previous studies which focus on benefits at the company level, equal attention should be paid to the needs of the users and the impact that the system has on the users. Therefore the viewpoints that will be adopted for the purposes of this study are those that represent the end-users within the organisation.

3.2.4. When to Measure Success

As discussed in section (Chapter 2), success can be measured at each phase of the ERP lifecycle. This research focuses on the factors that influence the quality in use. It is only during the Usage phase of the Adopter Life Cycle that it is possible to determine the quality in use (Markus & Tanis, 2000; Shang & Seddon, 2000). In particular, the year after go-live is the best time for uncovering and addressing user needs that are not being met by the system (Strong & Volkoff, 2010).

Further, as will be demonstrated in the following chapter, there are numerous factors during the implementation phase that are posited to affect the quality in use. Consequently, this study is positioned within the Implementation and Usage phases of the Adopter Life Cycle,

3.3. User Needs

Meeting user needs can be viewed as the fit between the user, the task and the technology, that is, the extent to which the system provides the functionality required by the users to effectively perform their tasks (Goodhue & Thompson, 1995). The Task-Technology Fit (TTF) theory is based on the premise that quality in use will increase if there is a good fit between the functionality that the system provides and the users' task requirements (Goodhue, 1995; Goodhue & Thompson, 1995). TTF has been used in prior research to determine the extent of the fit between an ERP system and the task needs of the intended users for example, (Chwei-Jen & Wei-Yuan, 2005; Kositanurit et al., 2006; Wu, Shin, & Heng, 2007)

However, quality in use and meeting user needs is more than just about functionality. Quality in use is a dimension of the broader concept of Software Quality, which is defined as "ability to satisfy stated and implied needs" (N. Bevan, 1999, p. 89) Therefore, it can be stated that "meeting user needs" refers to both the stated and implied needs of users. Within the context of quality in use, then, meeting user needs can be more broadly defined as the extent to which a product used by specified users meets their stated and implied needs to achieve specified goals with effectiveness, productivity, safety and satisfaction in a specified context of use.

In general, stated needs typically refer to the functionality of the system and resource constraints such as time and budget (Kotonya & Sommerville, 1998; Pressman, 1997). Stated needs thus include the IT management stakeholder view of ERP implementation success as discussed in section 3.2.3). On the other hand, implied needs refer to technical performance requirements, such as the reliability, changeability and robustness of the system, and operational performance requirements, that is, how well the users are able to use the system (Kotonya & Sommerville, 1998; Pressman, 1997).

While functional requirements relate to the task, operational performance requirements relate to the human issues that surround the use of computerised systems to perform the task, that is, the user characteristics (context) that shape the way in which users do their jobs. These user characteristics, as well as the functional requirements, are addressed within the usability discipline (for example N.. Bevan, 1995; Kirakowski & Cierlik, 1999; Mayhew, 1992). Usability is defined by the ISO 9126 standard in exactly the same way as quality in use, that is, "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use". Thus, usability is synonymous with quality in use (N.. Bevan, 1995): the purpose of both is to meet the needs of users within their context of use.

3.3.1. The Context of Use

As noted above, the context of use refers to the users, the tasks and the environment. Within the framework of the usability literature, the user context of use refers to the users' profile (Mayhew, 1992), which takes into consideration all the characteristics of the user that may influence his or her ability to use the system (Kirakowski & Cierlik, 1999). A product can be usable for a user with specific characteristics, but unusable for users with differing characteristics: "Users share common capabilities but are individuals with differences, which cannot be ignored" (Dix et al., 2004). These characteristics include (Ford, 2005):

- Skills and knowledge, such as hands-on experience with a particular software application, general computer experience, task experience in terms of the amount of training or experience that the user has had in the task domain, and training in terms of using computers, specific software products or on how to perform their job functions;
- Physical attributes, such as age, gender, and physical capabilities and limitations;
- Psychological attributes, such as the attitude of the users to their jobs, the use of technology in general, and to a specific technology, their motivation to use a particular type of software product, and their intellectual capabilities to process information, make decisions and solve problems; and
- User role, indicating whether the user is a direct, indirect, supporting or monitoring user of the system.

Similarly, the task context of use refers to all the characteristics of the task that could influence the user while using a computer-based system to complete that task (Ford, 2005). These characteristics include

- Task characteristics, such as the aim of the task, the activities that need to be performed in order to complete a specific task, the information that the task produces and the risk resulting from error;
- Task execution, which includes whether the use of the system is mandatory or voluntary, how important it is that the task is carried out or

completed, the extent to which the task is carried out by the user without supervision, how often the task is carried out, how long it takes to complete the task, whether the task must be completed in a certain way, and whether the user can postpone the completion of the task at any stage;

- Task flow, which refers to the extent to which any side effects of the task are required or to be avoided, any information or events that are required before the task can be started or completed, whether the task is carried out concurrently with other tasks, and whether any of the activities need to be performed within a specific time constraint; and
- Task demand on users, which include physical demands such as strength or visual capacity, and mental demands, such as the intellectual demands required to process information and make decisions (Ford, 2005).

3.3.2. The Importance of Stated and Implied Needs

Both stated needs and implied needs could severely impact on the ability of ERP users to achieve their goals effectively and efficiently (Topi, Lucas, & Babaian, 2005).

Prior research has reported that that it is common for gaps to arise between the functionality provided by an ERP system and the functionality required by the working practices of the users (Fitz-Gerald & Carroll, 2006; Gribbins, Subramaniam, & Shaw, 2006; Strong & Volkoff, 2010; Subramaniam & Venkatraman, 2001; E Wagner & Newell, 2004). These gaps in functionality, also referred to as Package-organisation misalignments (POMs) (Sia & Soh, 2007) or feature/function misfits (Markus & Tanis, 2000) occur because organisations and users have unique business requirements whereas ERP systems are designed to provide a generic solution in the form of "Best Practice" at the industry level (Strong & Volkoff, 2010)

Numerous types of misfits have been identified for different purposes (Davison, 2002; Kumar et al., 2003; Martinsons, 2004; Soh et al., 2000). For example, Kumar et al (2003) classified misfits into organisation-specific, business-specific and country-specific, whilst Soh et al (2002) identified the three categories of data, function and output misfits. A diverse range of frameworks has also been identified, for example, the Task-Technology Fit (TTF) Model as described above, Strong & Volkoff's (2010) Organisation–Enterprise System Fit, and Venkatraman's (1989) Fit Taxonomy.

The most pertinent of these frameworks for understanding the importance of implied and stated needs is the POM Assessment Framework (Sia & Soh, 2007), developed by Soh and her colleagues to define the nature of misfits and identify their sources so that they can be avoided. Initially classifying misfits as data, functional and output misfits (Soh et al., 2000), they then expanded their model to include data ownership, data entry, workflow, job scope, reports and revenue processing (Soh & Sia, 2004). Based on the concepts of deep and surface structure elements from Wand and Weber's (Wand & Weber, 1990) conceptualisation of information systems, the POM Assessment Framework (Sia & Soh, 2007) identifies two categories of misfits: deep structure misalignments and surface structure misalignments. Deep structure elements represent the entities that users deal with when they perform their work tasks (Satzinger, Jackson, & Burd, 2004). These entities, together with their respective properties, states and transformations, constitute the functionalities (stated needs) that the system provides. A customer order, for example, would be represented as an entity, and the standard operating procedures governing the ways in which the order is processed would be represented by the properties, states and transformations allowed on that entity. The surface structure elements, on the other hand, reflect the ways in which users interact with the functionalities of the system in order to accomplish their tasks, such as capturing data, accessing data and viewing reports. As such, the surface structure elements are seen to provide the implied needs of the users. The POM Assessment Framework can thus be viewed in terms of identifying both stated and implied user needs.

Further, Sia & Soh (2007) proposed that misfits arise from externally imposed or voluntarily created organisational processes. Imposed processes arise from demands made on the organisation from external entities, such as laws and regulations relating to the country, and practices established by industry and professional institutions within which the organisation operates. For example, the tax laws of a particular country would strongly influence the way in which transactions are recorded and reported. Professional institutions and occupational governing bodies, on the other hand, provide guidelines on professional conduct and therefore influence the way in which employees perform their tasks. In contrast, voluntary processes reflect the procedures, rules or norms that result from an organisation's tradition and experience, strategy and management preferences, and can therefore be likened to signature processes (see 2.4.1.1). Examples include task sequences, the data needed to place an order, and authorizations required to complete an activity or a task (Strong & Volkoff, 2010).

These two causes and two categories of misfits were then combined to identify four types of misfits: imposed-deep, imposed-surface, voluntary-deep, and voluntary-surface.

Missing deep structures always result in major deficiencies in the functionality provided by the system. Consider, for example, that the delivery of raw material required to manufacture a particular stock item has been delayed by several weeks, and the organisation wishes to send out a notification to all its customers who have placed an order for the stock item. If the relationship between a customer object, an order object and an inventory item object has not been defined, it would not be possible for the system to generate a report listing all these customers: in other words, a required function would be missing. Thus, missing functionality has a severe impact on the ability of the users to perform their tasks.

In contrast, Sia and Soh (2007) contend that misfits arising from missing surface structures have less of an impact, because they relate to the way in which users capture data, access and view information. However, it is argued here that this is not the case. Surface structures constitute the user interface (Hong & Kim, 2002; Strong & Volkoff, 2010), that is, the means by which the user interacts with the functionality of the system in order to accomplish their tasks. It is through these surface elements that the user and task context of use elements should be accommodated so that the user is afforded the opportunity to accomplish the task in a manner that best suits their skills, preferences, physical and psychological attributes, whilst taking into account the characteristics of the task. For example, Strong (2010) reported that the new enterprise system made changes to the sequence in which the activities needed to be carried out, and in some cases also made some tasks that were previously independent, interdependent. Thus, the way in which users were required to perform their tasks had to change to accommodate the system's embedded process logic, which in turn was reflected in the way in which the users interacted with the system in order to complete the task. As another example, Hong & Kim operationalised the concept of user interface fit as the extent to which the interface structures "are designed to the work structure required for conducting business", and the extent to which the user interface is designed "to the user capabilities" (2002, p 37). Because the user interface plays an increasingly essential role for mission-critical systems such as ERP systems, it can be argued that missing surface elements will have an equally strong impact on the ability of the users to accomplish their tasks.

From a functionality perspective therefore, ERP systems that are unable to support the required business functions indicates a poor task-technology fit, suggesting that the system will be of little use to the organisation and detrimental to the overall work performance of its users (Gebauer, Shaw, & Gribbins, 2006). From an implied needs perspective, poor technical performance can lead to system failures and poor response times (N.. Bevan, 1995). Of equal if not more importance, poor operational performance can lead to users being unable to perform their tasks using the system according to their preferences, skills, habits, physical and psychological capabilities and values.

3.4. Work Practice Compatibility

Numerous principles, guidelines and heuristics have been developed to assist in the design, development and evaluation of usable systems[1]. Usability principles are based on "aspects of cognitive psychology which have a bearing on the use of computer systems: how humans perceive the world around them, how they store and process information and solve problems, and how they physically manipulate objects" (Dix et al., 2004, p.12). Cognitive theories attempt to understand and model the cognitive processes that are required when carrying out everyday activities (Preece, Rogers, & Sharp, 2002). When these activities are supported by information systems, these models aim to represent the users as they interact with the system's interface (Dix et al., 2004), reflecting both limitations and weaknesses in human cognitive processes. This enables system developers to design systems that are easier to learn and use, by exploiting the capabilities and compensating for the limitations inherent in these cognitive processes. One fundamental principle of usability related to these cognitive processes is consistency (Dix et al., 2004; Preece et al., 2002; Shneiderman, 1998), which is discussed in detail below.

3.4.1. Consistency

Consistency has been defined narrowly as referring to similarities within a product (Mayhew, 1992), so that for example, the same types of information should be located in the same place and displayed in the same way on all screens (Nielsen, 1993). This allows the user to become familiar with the system more quickly and easily because it reduces the amount of learning required.

Consistency has also been more broadly defined in terms of external consistency and consistency with the real world (Grudin, 1989). External consistency, also known as product compatibility (Mayhew, 1992), relates to the design of systems being consistent with the design of other systems that users are familiar with, for example, that the "edit" menu option in MS Word is

[1] Readers are referred to Ford (2005) for a detailed discussion and comparison of the definitions of these terms, which is outside the scope of this study.

in the same place and performs the same function as the "edit" function in MS Excel. Consistency with the real world, also referred to as familiarity, relates to using metaphors, terminology, and other concepts that are known to the user.

Based on these definitions, consistency can therefore be understood to relate to existing and prior knowledge of the user, in terms of their current and previous experiences with computer-based systems.

3.4.2. Compatibility

However, Grudin (1989) argues that consistency in system design can be harmful to the user rather than helpful, and proposes that compatibility is a better design strategy. He suggests that the system should rather be compatible with the user's tasks and physical and psychological capabilities and limitations. For example, Grudin shows that consistency in menu defaults reduces performance, as the default option is determined based on the designer's idea of which option is most likely to be selected. However, menus are used for a variety of tasks and therefore the option that is most likely to be selected is dependent on the task being performed, and the user's preferred way of performing that task. Consequently, it is important to ensure that "the mechanisms of the system match the thoughts and goals of the user" (Grudin, 1989, p.1171).

Grudin's arguments against consistency and for compatibility highlight that the design of systems should be based not only on the prior experience, knowledge and skills of users, but also on their preferences, habits and values within their work context. This view is echoed by various definitions proposed by other researchers:

- Mayhew (1992) defines compatibility as the ability of the system to be consistent with the user's profile. In terms of the user context of use described above, this includes compatibility with the user's skills and experience, their habits and preferences based on the amount of training and experience that they have had in the task domain and in using other software products, and their values, all of which shape their attitudes towards the job and the use of technology.

- Moore & Benbasat (1991) define compatibility as "consistent with existing values, needs, and past experiences of potential adopters".
- Rogers (1983) defines compatibility as the degree to which using an innovation (technology) is perceived as consistent with the existing socio-cultural values and beliefs, past and present experiences, and needs of potential adopters (Rogers, 1983; p. 223), thus once again incorporating user needs in terms of values and experiences.
- Tornatzky and Klein (1982) define two dimensions of compatibility: normative or cognitive compatibility which refers to compatibility with what people feel or think about an innovation, and practical or operational compatibility, which refers to compatibility with what people do. These two types of compatibility are expanded forms of Rogers' definition of compatibility in that compatibility with values and norms "implies a kind of normative or cognitive compatibility", while compatibility with existing practices of the users "suggests a more practical or operational compatibility." (p 33)
- Taylor & Todd (1995) define compatibility as the "degree to which the innovation fits with the potential adopter's existing values, previous experiences, and current needs

Synthesizing the views of compatibility in prior research, Karahanna et al (2006) noted that although compatibility is conceptually viewed as a multidimensional construct, researchers continue to measure it unidimensionally. To overcome this problem, they reconceptualised compatibility into a multidimensional construct consisting of four dimensions, namely

1) Compatibility with existing work practices, which measures the extent to which a technology "fits" with a user's current work processes;
2) Compatibility with preferred work style, which measures the extent to which the technology allows the user to work according to their preferences;
3) Compatibility with prior experience, which measures the fit between the technology and the users' past experiences with similar technology; and

4) Compatibility with values, which measures the extent to which the technology matches the user's dominant values and beliefs (Karahanna et al., 2006).

The first three dimensions represent an expansion of Tornatzky & Klein's (1982) practical or operational compatibility. The fourth dimension – compatibility with values – was taken directly from Rogers' (1983) definition and is "subsumed in Tornatzky and Klein's normative or cognitive compatibility" (Karahanna et al., 2006, p. 784).

3.4.3. Work Practice Compatibility

Karahanna et al define compatibility as "the *perceived cognitive distance between an innovation and precursor methods for accomplishing tasks*" (2006, p.784), and state that "we eliminate compatibility with needs from our conceptualisation of this construct" (2006, p.783-784). However, it is argued here that their reconceptualised view of compatibility encompasses both the stated and implied needs of users[2].

Compatibility with existing work practices can be viewed as encompassing both implied needs as well as stated needs. The need to maintain current habits and work processes is an implied need within the user context of use, relating to existing skills and habits. In addition, Karahanna et al note that previous or existing methods of doing work are shaped by features of an individual's cognitive make-up that have been influenced by the target technology's precursors as well as by prior beliefs and experiences. Therefore, compatibility with prior experiences can be seen to include compatibility with the users' skills obtained during prior encounters with technology, as well as with their habits and preferences that they have developed as a result of their prior experiences. Compatibility with values can be seen as encompassing the attitudes and motivation levels that are shaped by users' values and beliefs. Thus, it can be said that compatibility with existing practices, preferences, prior experiences and values relate to the

[2] The lead author was emailed with a request for clarification on this issue, but no response was received.

implied needs of users in terms of the human issues that are included in the user context of use described above.

However, implicit in the two dimensions of existing practices and preferences is the functionality that is required in order to perform the task. Maintaining existing work practices cannot be achieved without maintaining existing functionality. Similarly, providing the user with the ability to work in a preferred way requires that the system takes into consideration all the task characteristics that may influence the user's method of execution of the task. These include for example, the activities that make up the task, the order in which the activities need to be completed, time constraints on activities, prerequisite information or events, the information that the task produces and the ability to postpone the start or completion of the task.

Therefore compatibility with existing work practices and compatibility with preferences can also be viewed in terms of the functional (stated) needs of users, suggesting that compatibility, as conceptualised by Karahanna et al, includes both stated and implied needs.

Thus it can be argued that meeting user needs refers to the extent to which the system is compatible with users' existing and preferred work practices, prior experiences and values.

To distinguish between Karahanna et al's (2006) conceptualisation of compatibility that does not include compatibility with needs and this study's conceptualisation of the construct, the construct is renamed as Work Practice Compatibility.

Work Practice Compatibility thus incorporates and extends the misfit categorisations of the TTF model. The model takes into account the tasks and the technology, and the fit between the former and the latter in terms of functional requirements. It does not, however, take into account the implied needs as reflected in the context of use, such as the users' skills and experience, psychological or physical attributes. Thus, from a TTF perspective, the implementation of a new ERP system will be considered successful if the system provides the required functionality specified by the new business processes. However, this does not take into consideration the impact of new business processes on an individual's work life, in terms of, for example, their habits, preferences, training, or beliefs about how to do their jobs. Work Practice Compatibility does, however, encompass the misfit categorisations of the POMS Assessment Framework discussed above.

Consequently it is concluded that the concept of user needs is encapsulated within the multidimensional construct of work practice compatibility, and further, that for the purposes of this study, Work Practice Compatibility is considered as the primary antecedent of Quality in Use.

3.5. Summary

The salient points of this chapter are reflected in Figure 11 and summarised below.

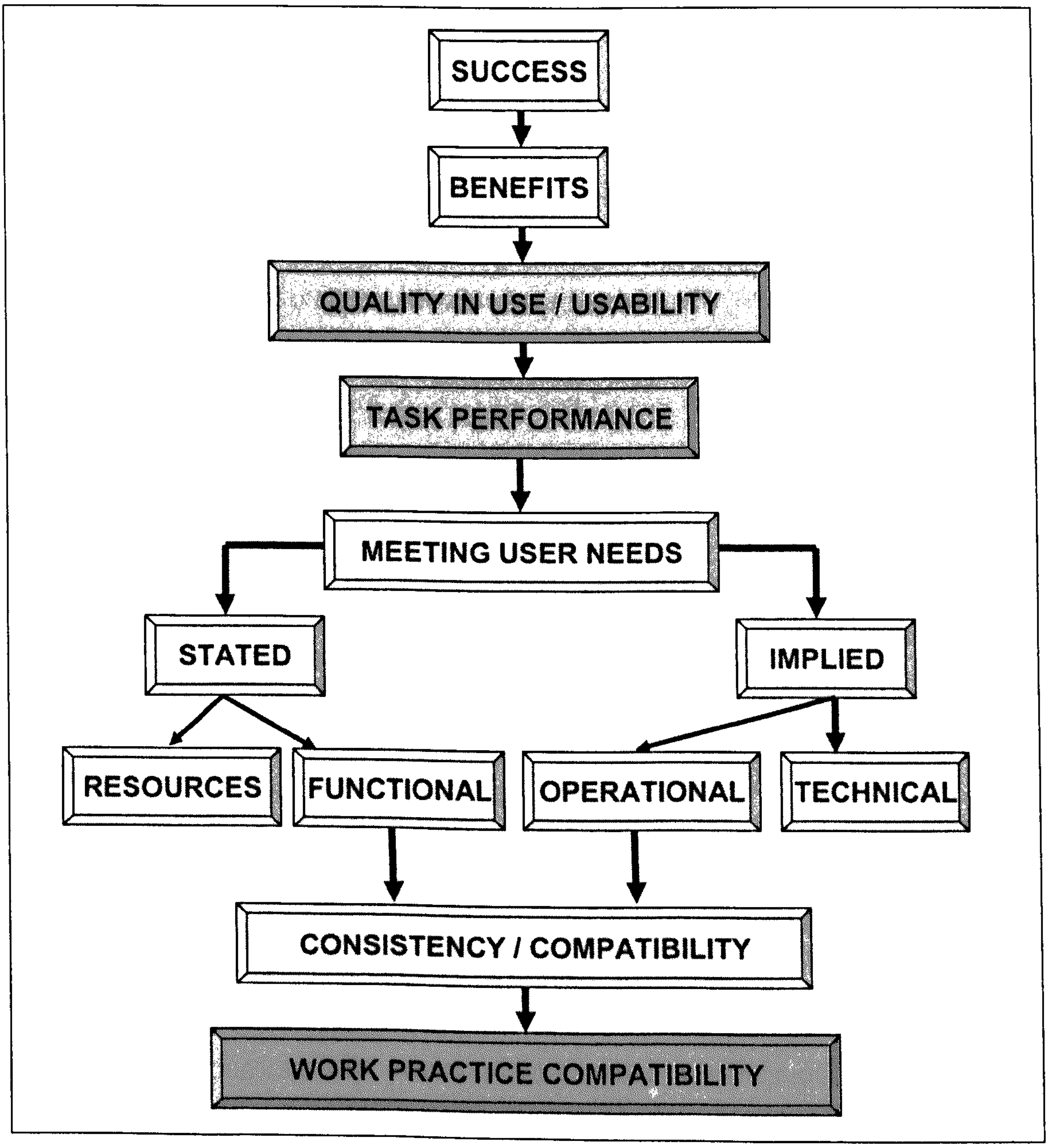
Reviewing the IS and Usability literature, it has been shown that ERP success should ideally be measured in terms of the benefits that accrue as a result of using the system. However, as benefits are difficult to measure and may produce unreliable results, a proxy is required. The traditional proxies of system usage and user satisfaction were shown to be inadequate; instead, quality in use, measured in terms of user task performance, was identified to be an appropriate proxy for measuring ERP success.

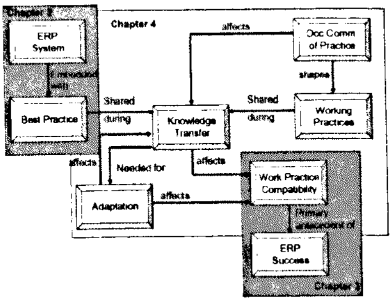
Drawing from the Usability and Fit literatures, it was argued that the ability of the users to accomplish their tasks effectively, efficiently and with satisfaction is primarily dependent on the ability of the system to meet users' needs. These needs encompass both stated or functional needs, as well as implied needs – the technical requirements relating to the system's behaviour as well as the operational requirements that relate to the user characteristics that shape the way in which the users perform their tasks. Based on the compatibility principle of usability, the multidimensional construct of Work

Practice Compatibility was identified as the primary critical factor for meeting user needs, and thus for enabling task performance (quality in use) and the expected benefits of adopting an ERP system.

In the next chapter, attention is turned to the factors influencing Work Practice Compatibility within the ERP context.

Figure 11: ERP System Success Concepts





CHAPTER 4

FACTORS INFLUENCING WORK PRACTICE COMPATIBILITY

"A little Consideration, a little Thought for Others, makes all the difference."

Winnie the Pooh - *Eeyore, Winnie the Pooh*

4.1. Introduction

In the previous chapter, quality in use, measured in terms of user task performance, was shown to be an appropriate proxy for measuring ERP success. The importance of Work Practice Compatibility as the key factor for achieving quality in use was also established. This chapter addresses the factors that influence Work Practice Compatibility within an ERP context.

To enhance Work Practice Compatibility when implementing an ERP system, it is necessary to adapt either the system to suit the needs of the users, or the users' existing practices to suit the business model embedded in the system. The ways in which adaptation can take place within an ERP implementation context is discussed in section 4.2.

Adaptation requires a bi-directional transfer of knowledge between the source (ERP implementation team) and the recipient (the intended users). This transfer of knowledge occurs mainly during the implementation phase of the knowledge transfer process. Transfer of knowledge is a difficult process with many known barriers that relate to the characteristics of the source, the recipient, and the transfer environment. The factors that affect the knowledge transfer process are described in section 4.3.

The intended users of ERP systems belong to diverse occupational communities of practice. Members of these communities display characteristics that have been shown to make the knowledge transfer process even more difficult (Bechky, 2003; Van Maanen & Barley, 1984; Wenger, McDermott, & Snyder, 2002). A review of the definitions and theories of occupational communities of practice is presented in section 4.4. The potential impact of occupational community of practice membership on the knowledge transfer process is also discussed in this section, which concludes the chapter.

4.2. Adaptation

Misfits occur because organisations and users have unique business requirements whereas ERP systems are designed to provide a generic solution based on "Best Practice" (Sia & Soh, 2007; E Wagner & Newell, 2004). Therefore, ERP systems need to be adapted to fit the organisation-specific context (Newell, Swan, & Galliers, 2000; Savage et al., 2010). To enhance the fit between the system and the users, and consequently Work Practice Compatibility, it is thus frequently necessary to either (1) adapt the system to suit the specific organisational and user work practices and task needs; (2) adapt the work practices of the users to suit the business model and processes ("Best practices") embedded within the system; or (3) a combination of both (Hong & Kim, 2002; Markus et al., 2000; Sia & Soh, 2007). As Gefen notes: "In other words, how useful the ERP is depends on how well it is customized to specific client work procedures" (2004, p.271)

4.2.1. System Adaptation

System adaptation can take the form of customisation or configuration. Configuration of the modules refers to the parameters that are selected from those provided within the system. These parameters generally encompass such issues as security levels, the various business documents that will be required to complete a particular task, task authorisation procedures and interdependencies, and the extent to which these parameters are standardised across the different organisational units. Configuration of these parameters are normally standardised across all organisational units, meaning that all parameters are set in the same way for all the units. A non-standardised approach can be used to accommodate organisational units with diverse business process needs, for example, task authorisation procedures may be more or less stringent, or some business documents may not be required to complete a task for a specific organisational unit. The main problem with using configuration as a system adaptation tool, however, is the limited flexibility that it allows: there is a finite set of parameters and a finite number of options for each parameter that is built into the system. If the organisational or user needs differ from those supported by these parameters and options, then configuration will not be an appropriate method for adapting the system to meet these needs.

Customisation, also known as package code modification (Brehm, Heinzl, & Markus, 2001) requires the reprogramming of one or more modules of the system to either add or modify the generic functionality that is shipped with the system, in order to provide support for additional tasks or to change the way in which the tasks can be performed using the system.

Organisations that deploy their ERP systems via SaaS are limited to the configuration option. As discussed in section 2.2.4, this currently amounts to approximately 9% of all organisations. However, for the remaining 91% of companies using off-site and on-premise deployed systems, there are many options between configuration and customisation. Brehm et al (2001) identify seven additional types of system adaptation that can occur between configuration and customisation, ranging from "Bolt-ons" which has one of the lowest impacts in terms of the amount of changes to the system, to interface developments, which has one of the highest impacts. Brehm et al refer to these 9 adaptation types as "ERP tailoring types" and are summarised in Table 7

Other than configuration, ERP system tailoring is generally strongly discouraged (for example Brehm et al., 2001; Markus et al., 2000; Sia & Soh, 2007) as it increases implementation time as well as the risk of introducing bugs into the system, making the system more complex than necessary, making integration more difficult, and increasing the risks and costs associated with future upgrades (Sia & Soh, 2007). The higher the impact in terms of the amount of changes to the system caused by the tailoring type, the higher the costs and risks will be. Consequently, it has been suggested that ERP implementation success depends on the type and extent of system adaptation (Brehm et al., 2001; Gefen, 2004).

Table 7: ERP Tailoring Types
(Source: (Brehm et al, 2001, p 6))

Tailoring Type	Description	Example
Configuration	Setting of parameters (or tables), in order to choose between different executions of processes and functions in the software package	Define organisational units; create standard reports; formulate available to-promise logic; use of a standard interface to an archive system
Bolt-ons	Implementation of third-party package designed to work with ERP system and provide industry-specific functionality	Provide ability to track inventory by product dimensions (e.g., 2 500 m. lengths of cable do not equal 1 1000 m. length)
Screen masks	Creating of new screen masks for input and output (soft copy) of data	Integrate three screens into one
Extended reporting	Programming of extended data output and reporting options	Design new report with sales revenues for specific criteria
Workflow programming	Creating of non-standard workflows	Set up automated engineering change order approval process
User exits	Programming of additional software code in an open interface	Develop a statistical function for calculating particular metrics
ERP programming	Programming of additional applications, without changing the source code	Create a program that calculates the phases of the moon for use in production scheduling
Interface development	Programming of interfaces to legacy systems or 3rd party products	Interface with custom-build shopfloor-system or with a CRM package
Package code modification	Changing the source-codes ranging from small change to change whole modules	Change error message in warning; modify production planning

4.2.2. Process Adaptation

Adapting the system to suit user needs requires significant cost and time, and many organisations choose instead to adopt vanilla implementations – implementing the system as is, without changes. With vanilla implementations, users are required to make the necessary adjustments to their existing working practices to match the functionality and work practices embedded within the system. This can require changes to processes, policies, organisational structures and roles (Sia & Soh, 2007). The impact of the process adaptation can be minor, for example, accepting a different report format or encompassing an additional processing step within a particular task or activity. On the other hand, the impacts could be major, for example, the organisation may need to change its organisational unit structures to accommodate the cross-functional / process-oriented structure of the business processes embedded in the package (see 2.4).

The problems associated with adapting existing work processes are numerous: the extant literature has to date identified significant factors such as resistance to change, the cost of organisational change management and the loss of productivity during the transition process (Brehm et al., 2001; Markus & Tanis, 2000; Savage et al., 2010; Skok & Legge, 2002). Resistance to change is a well-established key success factor in technology innovations (for example Hirscheim & Newman, 1988; H. Klaus et al., 2000; Sheth et al., 2000), and will be discussed in more detail in section 4.3 Changes to existing work processes reduce consistency in terms of users' habitual ways of working (see section 3.4.1). This in turn requires that users learn new ways of working, which are initially prone to errors during the learning phase and thus incur additional costs to rectify (Dix et al., 2004; Preece et al., 2002). Organisational change management initiatives are therefore required to overcome the problems relating to resistance to change as well as reducing the costs incurred during the transition phase from the old system and ways of working to the new system and new ways of working.

4.2.3. Enhancing Work Practice Compatibility

Regardless of which adaptation method is chosen however, the objective of the adaptation process should be to align the packaged software's embedded functionality with the needs of the users (Gefen, 2004; Hong & Kim, 2002; E. T. G. Wang, Lin, Jiang, & Klein, 2007). As discussed in the previous chapter, this adaptation process should take into consideration both functional as well as operational needs, thus enabling:

- Compatibility with existing work practices,
- Compatibility with preferred work practices,
- Compatibility with prior experience, and

- Compatibility with values.

This will lead to a better fit between the system and the users, thus enhancing work practice compatibility and the resultant quality in use.

4.3. The Knowledge Transfer Process

There are many definitions of knowledge transfer in the literature (Ko et al., 2005; Lin, 2003; Xu & Ma, 2008). Historically, knowledge transfer was synonymous simply with knowledge exchange; more recently, knowledge transfer research is based on a "source and recipient" generic model (Ko et al., 2005).

Knowledge transfer can occur as an intra-firm transfer of knowledge, for example, transferring a particular manufacturing process between factories within a single organisation, or as an external transfer of knowledge, for example, importing business processes from other organisations within a particular industry. The main intention of both types of transfer is to obtain similar results by creating an exact or partial replica of the source's processes and practices within the recipient unit or organisation (Szulanski, 2000). This process is known as replication (Szulanski, 2000) or the transfer of knowledge and Best practice (O'Dell & Grayson, 1998).

The adoption of a new technology can be seen as a knowledge transfer process (Newell et al., 2000). Complex technologies such as ERP systems are a combination of knowledge and ideas bundled together into a generic package that can be used by any organisation within a specified industry. These packages are then presented to potential adopters as relatively simple, "best-practice" solutions, whilst at the same time concealing their underlying complexity. The knowledge embedded within the package is commodified in this way so that it can be presented as a fixed entity that can be slotted into any organisational context.

However, the implementation of an ERP system requires the adoption of the Best practices embedded within the system to a larger or lesser extent, depending on the level and type of adaptation chosen. The packaged knowledge thus requires unpacking so that sense can be made of the various ideas and practices contained within the package and integrated with existing organisational knowledge (Newell, Huang, Galliers, & Pan, 2003). Thus, ERP implementations can be viewed as an external transfer of knowledge between organisations within a particular industry (Ko et al., 2005). In addition, the adaptation process itself requires the transfer of knowledge: The implementation team will need to transfer knowledge about the business processes embedded in the system to users who learn and apply this knowledge (Z. Lee & Lee, 2000; Volkoff, Elmes, & Strong, 2004). Similarly, users will need to transfer knowledge to the implementation team who apply this knowledge by customising and/or configuring the system to better suit the requirements of the users (Ko et al., 2005; E. T. G. Wang et al., 2007; Xu & Ma, 2008)

Effective ERP implementations, including adaptation efforts, thus require a two-way transfer of knowledge: knowledge about the users' current and preferred working practices, values and prior experiences with technology needs to be transferred to the implementation team, and knowledge of the system's embedded business processes needs to be transferred to the users (E. T. G. Wang et al., 2007; Xu & Ma, 2008). When this knowledge is transferred successfully, users and the implementation team should have a better understanding of the differences between work practices, values and experiences and the processes embedded in the system. This in turn, should lead to more effective adaptation, resulting in a system that better meets the needs of the users, and the quality in use that is required for ERP system success. Hence, this knowledge transfer process is a critical success factor for ERP adoption success (R. Chan & M. Rosemann, 2001; Jones, Cline, & Ryan, 2006; Z. Lee & Lee, 2000; Parr, Shanks, & Darke, 1999; Volkoff & Sawyer, 2001; Willcocks & Sykes, 2000).

There are several views about when knowledge transfer can be said to have taken place. Some researchers take a simplistic view and consider the transfer to be complete when knowledge is simply exchanged, whilst others take into consideration the changes that the knowledge incurs on the recipient. However, the expected benefits of ERP system adoption can only be achieved through the use of the system (see section 3.2.1), suggesting that the knowledge about the system needs to be both communicated and applied. Thus, the transfer of knowledge should incorporate both knowledge movement and knowledge application. Consequently, Ko et al's definition of knowledge transfer is adopted for the purposes of this research study, namely that knowledge transfer is "the communication of knowledge from a source so that it is learned and applied by a recipient" (Ko et al., 2005, p.62)

4.3.1. Phases of Knowledge Transfer Process

Knowledge transfer is a lengthy and iterative process. Numerous models of the process and its phases have been proposed in the literature (Lin, 2003). Although developed to explain intra-firm knowledge transfer, Szulanski's (2003) model is seen to be the most appropriate of the above-mentioned models for ERP implementation research (Ko et al., 2005; Timbrell et al., 2001), for three main reasons. Firstly, Szulanski's model is based on Shannon & Weaver's (1949) theory of communication, thus sharing a common conceptual foundation with the DeLone & McLean model (1992, 2003) of IS Success (discussed in 3.2.1) which was used to derive the definition of ERP success for this research. Secondly, Szulanski's model analyses the transfer of Best practices, which is the basic premise on which ERP systems are developed (see chapter 1). Finally, Szulanski's model specifically incorporates an analysis of the effects of certain characteristics of the source, the recipient and the practice on the transfer process. As will be demonstrated in the following section, these characteristics are posited to play a critical role in successful ERP implementations, particularly in an occupational community of practice context.

Szulanski argues that Best practice transfer should be regarded as a process rather than an event. He identifies four phases for this process, as described below (2000; 2003):

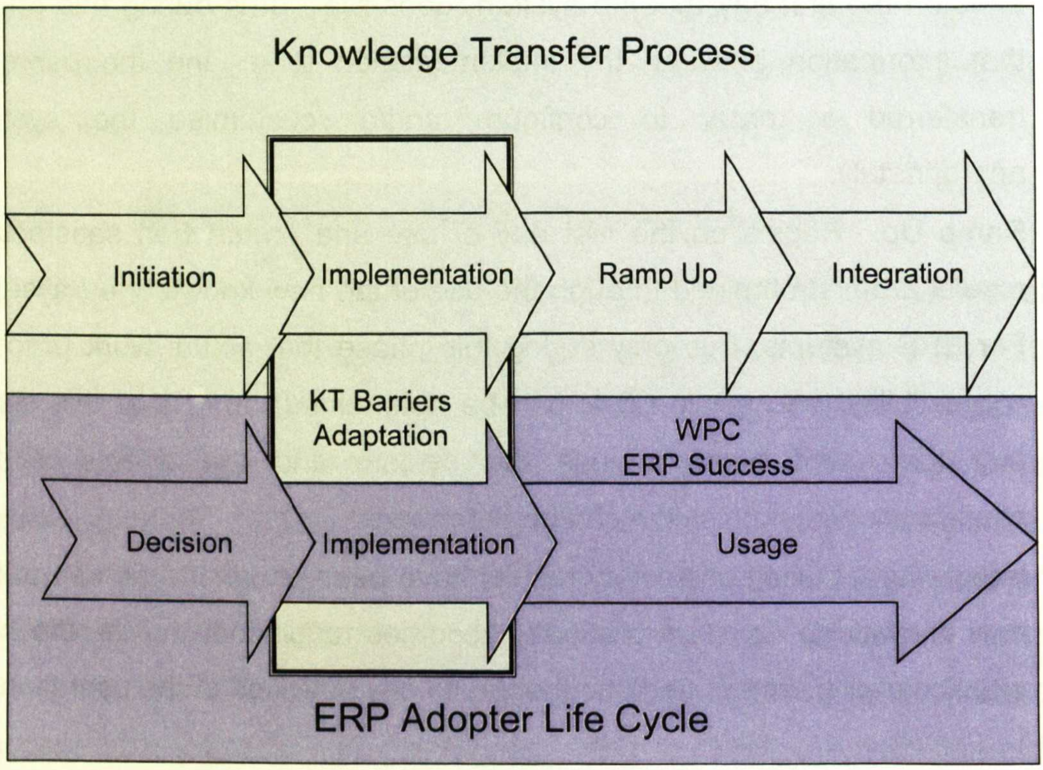
- Initiation: Begins with the formation of a need and ends when a decision to transfer is taken. Within an ERP context therefore, the initiation phase ends when a decision to acquire an ERP system is taken.
- Implementation: Begins when a decision to transfer is taken and ends on the first day of use. Within an ERP context therefore, implementation ends on the first day that the system "goes-live". It is during this phase that information between the implementation team and the users is transferred in order to configure and/or customise the system appropriately.
- Ramp Up: Begins on the first day of use and ends when satisfactory results are first obtained through the use of the new knowledge / system. For ERP systems, it is only during this phase that actual work practice compatibility (see section 3.4) can be determined, as it is at this stage that the users begin to use the system and the effects of the configuration/customisation can be determined.
- Integration: Once satisfactory results have been obtained, the use of the new knowledge / system gradually becomes routinised, that is, the new practices will be integrated into the day to day activities of the users.

It is during the implementation phase that knowledge about the Best practices and working practices is exchanged between the recipient and the source. This knowledge is imperative for configuring and customising the system to effectively meet the requirements of the users. Thus it can be argued that the implementation phase of the knowledge transfer process is the most crucial phase for attaining acceptable levels of work practice compatibility.

Comparing the phases in the knowledge transfer process to the phases in the ERP Adopter life cycle, it can be seen that the phases of each tend to parallel one other (Figure 12). As discussed previously, Work Practice Compatibility and ERP success can only be determined during the Usage phase of the ERP

Adopter life cycle. However, the level of stickiness (discussed next) encountered during the knowledge transfer process is a matter for determination during the implementation phase of both the knowledge transfer process and the implementation phase of the ERP Adoption life cycle. Therefore, this study is positioned within the implementation and usage phase of the ERP Adopter life cycle, and the implementation phase of the knowledge transfer process.

Figure 12: Knowledge Transfer Process and ERP Adopter Life Cycle Phases



4.3.2. Factors Affecting Knowledge Transfer

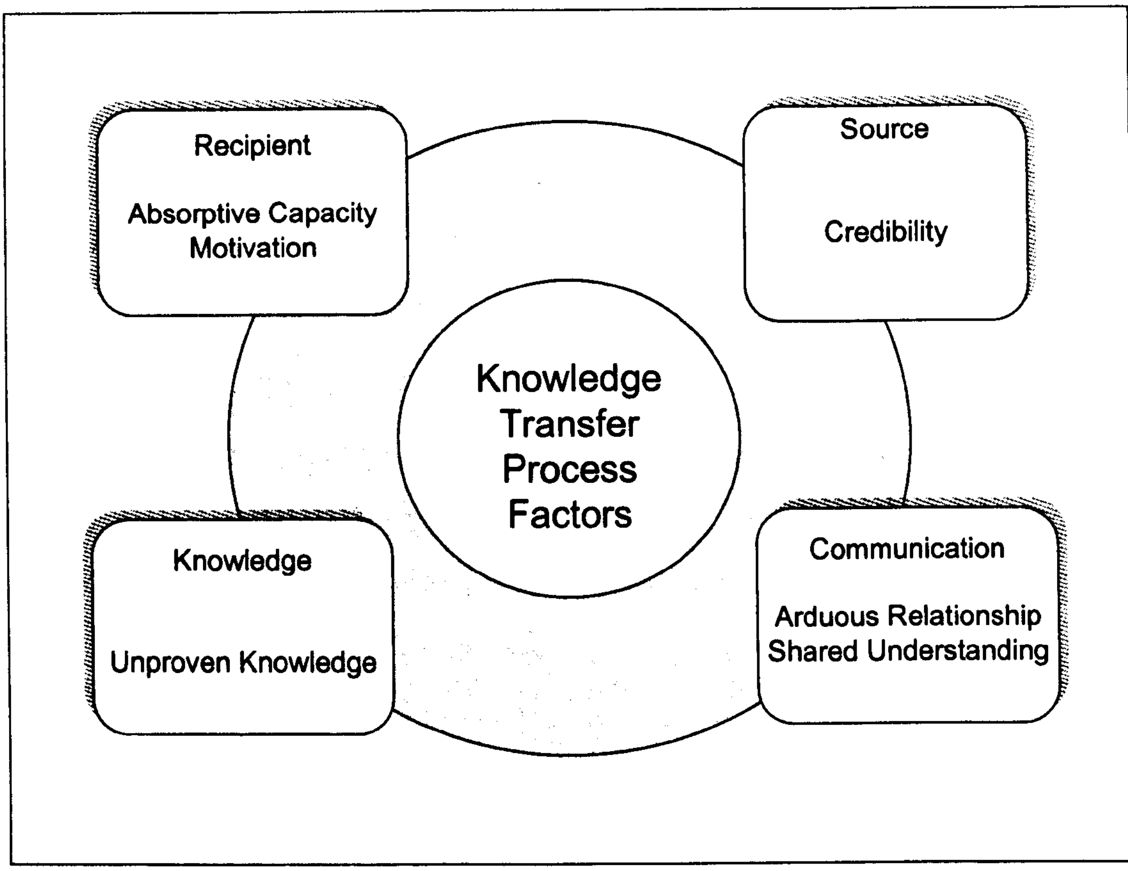
Effective knowledge transfer, whether internal or external to the organisation, is strongly influenced by the levels of stickiness – the difficulty in transferring knowledge – between a source and a recipient (for example Argote, McEvily, & Reagans, 2003; Ko et al., 2005; Nonaka, 1994; Szulanski, 2003; Timbrell et al., 2001). Effective knowledge transfer therefore requires an understanding of the origins of stickiness within the transfer process in order to incorporate appropriate interventions to reduce the most significant barriers.

Szulanski identifies 9 origins of stickiness which he groups into the 4 categories of characteristics of the recipient, characteristics of the source, characteristics of the knowledge and characteristics of the environment. His analysis of these barriers included their relative importance during each phase of the knowledge transfer process. These results were surprising: contrary to expectations, knowledge factors consistently superseded motivational factors during each phase. In particular, for the implementation phase (the phase within which this study is positioned), the knowledge factors of absorptive capacity, causal ambiguity and arduous relationship ranked as the top three most important factors respectively. Recipient motivation, which was expected to rank first, ranked fourth, with source motivation ranking even lower.

Other studies within the IS domain partially reinforce Szulanski's (2003) results with regard to some of the knowledge factors, but contradict his results in terms of the motivational factors (Ko et al., 2005; Timbrell et al., 2001). In addition, the IS literature reports that communication factors are also of critical importance in the knowledge transfer process, particularly during the implementation phase when the knowledge is being transferred (Ko et al., 2005).

Figure 13 reflects the barriers to knowledge transfer selected for inclusion into this study. These barriers were selected by synthesizing the results of prior studies within the ERP domain and identifying those factors that were empirically shown to have an impact on the implementation phase of the knowledge transfer process. These factors were then grouped according to Szulanski's three categories of recipient, source and knowledge. To highlight the importance of communication during the transfer process, Szulanski's (2003) original category of Context is renamed here as Communication.

Figure 13: Proposed Factors Affecting the Implementation Phase of the Knowledge Transfer Process



4.3.2.1. Recipient Characteristics

Szulanski identified three recipient characteristics – absorptive capacity, retentive capacity and motivation. Retentive capacity refers to the recipient's ability to integrate and routinise new knowledge. Although found to be of high importance during the Ramp-up phase, Retentive Capacity was found to have little impact on the implementation phase (Szulanski, 2003; Timbrell et al., 2001), and is thus not included in this study.

Absorptive Capacity (AC)

The definitions and operationalisations of Absorptive Capacity vary considerably in the literature (Lin, 2003). The most widely cited definition is that of Cohen & Levinthal (1990), who define absorptive capacity as the firm's ability to recognize the value of new, external knowledge, assimilate the knowledge, and apply knowledge to commercial ends. According to Cohen & Levinthal (1990), absorptive capacity is primarily a result of prior related knowledge and experience. A recipient that lacks absorptive capacity will be less likely to recognise the value of new knowledge, less likely to recreate that knowledge and less likely to apply it successfully. Szulanski found this to be the most significant barrier during the implementation phase, whilst Timbrell (2001) found it to be the second most important within an ERP context.

At the most fundamental level, this prior knowledge includes basic skills and a shared language, but may also include knowledge of the most recent developments in a given field (Szulanski, 2003). Based on this definition, absorptive capacity refers to knowledge about the work domain, that is, the training and/or experience that provides users with the required knowledge to perform their jobs.

Within the ERP context, Park et al (2007) operationalise this construct in terms of prior knowledge relating to the technology, and extends the absorptive capacity construct into the three interrelated components of users' capacity to (1) understand external knowledge, (2) assimilate knowledge into their task environment, and (3) apply the knowledge to the task. Their results provide empirical evidence that a strong pre-existing knowledge base relating to the system enables recognition of the value of new information, the ability to assimilate it and use it effectively when performing tasks.

Consequently, for the purposes of this research study, Absorptive Capacity is operationalised into a multidimensional construct consisting of two dimensions. These are

(1) **System Domain Knowledge** – the users' ability to understand the functionality and general business process logic of an ERP system well enough to apply the technology when conducting their work. This is what Park et al (2007) refer to as understanding ERP systems in technical terms.

(2) **Work Domain Knowledge** – the users' ability to understand the tasks and work practices that comprise their jobs. Having a solid understanding of the work that needs to be performed enables users to better understand how the new system fits into the work domain, as well as providing the users with

sufficient work domain knowledge to implement the new system effectively. This is what Szulanski refers to as technical competence.

Motivation

Within the context of knowledge transfer, motivation refers to the willingness of the recipients to learn the new knowledge / processes (Szulanski, 2003). As opposed to the *ability* of a recipient to learn, apply and integrate new processes, motivation refers to the *willingness* of the recipient to do this. Thus, a recipient may have high absorptive capacity but may not be willing to accept the new knowledge.

According to Szulanski (2003), the true motivation of the recipient is likely to be revealed during the implementation stage. The recipient may ignore the source's recommendations out of misunderstanding, resentment or to preserve pride of ownership and status. The lack of motivation may present itself at any stage during the ERP adopter life cycle (T. Klaus, Wingreen, & Blanton, 2007; Szulanski, 2003), and can take the form of resistant behaviours, for instance, foot-dragging and sabotage, or attitudes and perceptions, such as the Not-Invented-Here syndrome.

This construct could be viewed more broadly as Resistance to Change or User Resistance, which has an extensive body of knowledge in the literature (Hirscheim & Newman, 1988; T. Klaus et al., 2007; Sheth et al., 2000). Resistance to change is defined in the management literature as "the forces against change in work organisations" (Mullins, 1999, p.824). User resistance is more specific than overall resistance to change, as it involves people working with a computer-based system (T. Klaus & Blanton, 2010; T. Klaus et al., 2007). Based on this perception, Klaus et al define User Resistance as "the behavioural expression of a user's opposition to a system implementation during the implementation" (2010, p.627). A comparison of the definitions provided by Szulanski (2003) and Klaus (2007; 2010) thus suggests that Motivation and User Resistance can be used interchangeably within the context of this research, as both conceptualisations include resistance behaviours as well as attitudes. To maintain as much consistency as possible with Szulanski's (2003) original model, it was decided to adopt his "Motivation" conceptualisation of this construct for this study.

There is an extensive body of literature around the factors that influence both motivation and resistance, much of which is outside the scope of this study (Hirscheim & Newman, 1988; Jiang, Muhanna, & Klein, 2000; T. Klaus & Blanton, 2010; Ram & Sheth, 1989). However, the literature that suggests that there are interdependencies between the barriers, and more specifically, between Motivation and the other barriers, are of particular relevance to this study, and are discussed in more detail in Section 4.3.2.5.

4.3.2.2. Source Characteristics

Szulanski identified two factors relating to this category, source credibility and source motivation. Within the ERP implementation context, source motivation is not a useful criterion for studying barriers to knowledge transfer, as the "source" in such cases refers to the ERP vendor or ERP implementation consulting firm. Szulanski contends that a knowledge source may be reluctant to share knowledge for fear of losing ownership or status, or simply due to a lack of recognition for their efforts (Szulanski, 2000). As discussed above, ERP system knowledge is commodified (Newell et al., 2000) and thus may well be considered as esoteric and privileged by the knowledge source. However, as the source's business well-being is dependent on the success of the implementation, it can be accepted that the source's "motivation" to transfer the required knowledge is likely to be at a level that will facilitate, rather than impede, the transfer process.

Consequently, source motivation is excluded from this study and source credibility is the only factor in this category that is included for further investigation.

Source Credibility (SC)

Source Credibility refers to the perception of the users of the credibility of the source of the knowledge – the degree to which the donor of the Best practice is perceived to be reliable and trustworthy (Szulanski, Cappetta, & Jensen, 2004). Within the context of an ERP implementation, the need for trust is essential (Gefen, 2004). The implementation of an ERP system can result in a considerable improvement in the company's performance, but can also have extremely detrimental effects if unsuccessful. In particular, and as discussed above, ERP implementations require some level of adaptation to align the system to the specific organisational needs. User organisations depend on vendors and/or implementation consultants to perform this customisation effectively, which in turn, reflects the importance of the role that trust plays in the implementation process (Gefen, 2004) When the source is perceived to be credible, the knowledge offered by the source tends to be viewed as useful, thus facilitating the transfer of knowledge (Ko et al., 2005). When the source is not perceived as reliable, trustworthy or knowledgeable, initiating a transfer from that source will be more difficult, as recipients will be more likely to dismiss and reject the knowledge (Szulanski, 2003).

Szulanski found that source credibility was not a significant factor in his study. In contrast, other IS-related studies have reported that this factor to be of significance during the implementation phase of knowledge transfer within the ERP context (for example Gefen, 2004; Ko et al., 2005; Timbrell et al., 2001). Gefen summarises the importance of source credibility by noting that "trust determines, among other things, the expected utility people expect to gain from the business interaction... in proving reliable will substantiate the willingness of the trusting party to depend on the other individual or group" (2004, p 264).

4.3.2.3. Knowledge Characteristics

Szulanski identified two factors within this category – causal ambiguity and unproven knowledge. Causal ambiguity – "the absence of know-why ... why something is done, and why a given action results in a given outcome" (Timbrell et al., 2001, p.118) – was found to be of relative unimportance in the context of ERP implementations (Timbrell, 2001) and is therefore not explored further in this study.

Unproven Knowledge

Unproven knowledge refers to whether the knowledge being transferred has previously been shown to be of use by others in similar contexts. Knowledge with a proven record of past usefulness is less difficult to transfer, because there is proof that the knowledge is effective within similar contexts. Recipients of unproven knowledge therefore may be sceptical of its relevance (Szulanski, 2003), and thus it may be more difficult to persuade users to accept the knowledge (Rogers, 1983). In particular within the ERP context, due to the need to adapt business processes to some extent, unproven knowledge makes it even more difficult to justify these changes. Thus, when there is evidence that the knowledge has proven to be robust in other environments, and the source is reputable, uncertainty is reduced.

Unproven knowledge was ranked as the second most important factor in the ramp-up phase of the transfer process within an ERP implementation context (Timbrell et al., 2001), and only seventh in importance in the implementation phase. In contrast Szulanski found this factor to rank fourth during the implementation phase within an inter-firm context, and of no relative importance during the ramp-up phase. Despite the relatively low rankings of this factor reported during the implementation phase, it is posited that within the occupational communities of practice context the factor may take on a more important role (see Section 4.4.3).

4.3.2.4. Communication Characteristics

As noted above, Szulanski's original category of Context is renamed in this study as Communication to highlight the importance of communicating information during the transfer process. He identified two factors within this category – barren organisational context and arduous relationship. Arduous relationship is included in this study as it has been found to be important (Ko et al., 2005; Markus et al., 2000; Robey et al., 2002; Soh et al., 2000; Szulanski, 2003). Barren organisational context is operationalised in terms of the facilities provided at the organisational level and is thus considered outside the scope of this study. Instead, shared understanding (Ko et al., 2005) which has been found to influence knowledge transfer has been incorporated.

Arduous Relationship

Arduous relationship refers to the nature and quality of the relationship between the source and the recipient, and has been found to be a critical factor in successful intra- and inter-firm knowledge transfer (Argote et al., 2003; Ko et al., 2005; Szulanski, 2003). Defined as an emotionally laborious and distant relationship between a source and a recipient (Szulanski 1996), it affects the ability of the source to transfer the required knowledge and the ability of the recipient to learn and apply that knowledge (Ko et al., 2005). Within an ERP implementation context, of an ERP implementation, ease of communication between the consultant or implementation team and the intended user is crucial, as the transfer process requires regular interaction (Nonaka, 1994). Users may require additional explanations to verify the relevance of the new system to their needs. Likewise, consultants may need additional information from the users to understand and fill gaps in their knowledge about the new system. The success of these interactions is dependent on the ease of communication.

Shared Understanding

Shared Understanding is defined as the similarity in the source and recipient's work values, norms, philosophy, problem-solving approaches, and prior work experience (Ko et al., 2005). Without a shared understanding, there is a tendency for the parties to disagree about what they are doing and why, which leads to poor outcomes (Ko et al., 2005).

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Within an ERP implementation context, a shared understanding between consultants and users in terms of their prior work experiences, values and problem-solving approaches is argued to lead to a greater likelihood that they would be able to work together effectively to achieve a positive outcome. For example, Soh et al (2000) found that knowledge transfer between key users and ERP implementation teams was severely hindered due to the diversity in backgrounds, interests and knowledge bases of the participants. A shared understanding therefore makes it easier to transfer knowledge between a source and a recipient, due to an increase in understandability.

4.3.2.5. Interdependencies between barriers

Based on the above definitions of the barriers to knowledge transfer, it is evident that there are interdependencies between these (Ko et al., 2005; Szulanski, 2003), and that these interdependencies can be argued in both directions.

For example, Szulanski suggests that source credibility may increase recipient willingness to accept the new knowledge (recipient motivation), but could at the same time reduce the recipients' need to validate the usefulness of the knowledge (unproven knowledge). In contrast, it could equally be argued that the more useful the knowledge has been proven to be in similar contexts, the more credible the source will be perceived to be. Similarly, Ko, et al. (2005) posited that source credibility could also affect the quality of the relationship between the recipient and the source. Their findings reported that the more credible the consultant was perceived to be, the less arduous the relationship between the consultant and the user tended to be. Similarly, Bashein & Markus (1997) reported that IS specialists were excluded from strategic initiatives in which IT played a critical role, because they were perceived to have little credibility.

Although only one interdependency between the arduous relationship barrier has been linked with one other barrier in the literature, other barriers can clearly be seen to be related to this factor as well. Arduous relationship refers to the recipient's willingness to communicate and collaborate with the source. Thus, unproven knowledge, motivation and shared understanding can be seen as affecting, or being affected by, the arduousness of the relationship between the source and the recipient.

The same argument holds true for the Motivation factor. For example, it is evident from the above that difficulties in communication (arduous relationships), lack of source credibility, unproven knowledge and a lack of shared understanding can adversely affect the users' willingness to accept the new system (recipient motivation). For example, consultants who have different work practices and values to those of users may be considered unreliable and ill-equipped to provide a system that meets user needs, thus reducing the motivation of the users to accept the system that is being provided. In contrast, it is equally plausible to argue that the motivation of the recipients has an effect on these barriers. For example, a lack of motivation could be seen to reduce shared understanding and increase the arduousness of relationships because recipients would be unwilling to communicate and/or make the effort to bridge any communications gaps with the implementation team.

An investigation of the full spectrum of the interdependencies between the knowledge transfer barriers falls outside the scope of this study. However, to reduce the complexity of the study's research model, it was necessary to identify these interdependencies so that a subset could be selected for inclusion into the model. This aspect is discussed further in section 5.4.2.

In summary, this section has discussed the importance of the knowledge transfer process for enhancing the compatibility of the system to the needs of users. To provide a fuller understanding of the problems associated with ERP success, it is necessary to understand the factors that shape user needs and how these factors may influence the knowledge transfer process. This is discussed next.

4.4. Occupational Communities of Practice

Changing a business system, as in the case of implementing an ERP system, will affect the people associated with that business system (Toomey, 2009, p.228). The nature of the people involved determines how they will react to that change. Therefore, when implementing a new technology, it is important to understand the behaviour of people as individuals, and as a consequence of the communities that are involved. The organisational environment comprises multiple occupational communities of practice (OCoPs) – a "community of communities of practices" (J. S. Brown & Duguid, 2001). For example, employees within the accounting and finance department may belong to the Institute of Chartered Accountants, or employees within the sales and marketing function may be members of the Chartered Institute of Marketing. The working practices of the members of these OCoPs are shaped, to a large extent, by the rules and policies that govern the community, and also influenced by the training, organisational experience and apprenticeship programme that members undergo in order to become fully fledged and capable members of the community (H. M. Trice, 1993). In general, OCoPs display specific characteristics that are enhanced by a strong sense of commitment to the community. These characteristics could adversely affect the knowledge transfer process, which, in turn, could affect the adaptation process required to enhance the fit between the users' work practices and the work practices embedded within the system.

These communities influence, to a large extent, the working practices of their members, thus influencing user requirements of the system, and potentially causing conflicting requirements between each other.

A brief review of communities of practice is provided, followed by a more detailed discussion of occupational communities of practice. A comparison is drawn between occupational and professional communities of practice. The characteristics of these communities that appear to be most relevant to this study are discussed, in terms of their posited effects on the knowledge transfer process.

4.4.1. Communities of Practice (CoPs)

The term "Communities of Practice" was coined by Lave & Wenger (1998) to refer to the community that acts as a "living curriculum" for apprenticeship systems (Wenger, 2006). A community of practice is defined as "groups of people who share a concern, a set of problems, or a passion about a topic and who deepen their knowledge and expertise in this area by interacting on an ongoing basis" (Wenger et al., 2002, p.4). To distinguish a community of practice from a general community (Wenger, 2006), three characteristics are required (Wenger et al., 2002):

- A Domain – the community of practice needs to have a common domain of interest from which its identity is derived. Members of the community are thus expected to display a commitment to that field of knowledge and to have a shared competence that distinguishes them from people outside of the community.

- A Community – although it is not necessary for members to work together on a daily basis, the concept of a community requires that members need to interact regularly. Such interaction usually takes the form of joint discussions or activities, helping each other and sharing information. In essence, this interaction leads to the building of relationships so that members can learn from each other.

- A Practice – members of a community of practice are practitioners. They build a common set of tools, language, routines, artefacts (Wenger, 1998) and ways of addressing issues which leads to the development of a shared practice within the specific domain.

Communities of Practice can relate to many different types of groups of people, including those who share a similar line of work or occupation. These are referred as Occupational Communities of Practice (Bechky, 2003; Van Maanen & Barley, 1984). The members of occupational communities of practice are the intended users of ERP systems, and are therefore the focus of this study.

4.4.1.1. Occupational Communities of Practice (OCoPs)

Occupational Communities of Practice are defined as:

- "a group of people who consider themselves to be engaged in the same sort of work;
- whose identity is drawn from that work
- who share with one another a set of values, norms and perspectives
- that apply to but extend beyond work-related matters" (Van Maanen & Barley, 1984, p.287)

For the purposes of this study, professions are viewed as occupational communities. The concept of professional communities of practice has attracted an extensive debate in the literature (for example Abbott, 1988; Bloor & Dawson, 1994; Scott, 2008; Turner & Hodge, 1970) which falls outside the scope of this thesis. Relevant to this study, however, is Wang et al's (2004) observation that professional communities are defined in exactly the same way as occupational communities of practice, that is, in terms of their members' strength of identity and involvement with the community. This notion is supported by Van Maanen & Barley's observation that "when unpacked by speciality and interest... they differ from other lines of work (and each other) only by virtue of the relative autonomy each is able to sustain within the political economy of a given society" (Van Maanen & Barley, 1984, p.287). The characteristics of community of practice members are discussed in more detail in section 4.4.2.

Occupational communities tend to create unique "work cultures" consisting of codes of conduct that include standards for appropriate behaviour as well as working practices (Van Maanen & Barley, 1984).

As with communities of practice in general, the concept of practice within occupational communities includes the language, tools, symbols, and procedures that relate to the community. Within the context of occupational communities, this domain of interest relates to the work that is being carried out within the occupational domain, in other words, the shared practices that have been developed by and within the community. These shared practices include not only the explicit, but also the tacit knowledge that is contained within the community. Such tacit knowledge relates to the historical and social context that shapes the occupational community: the underlying assumptions, shared world views, traditions and rules of thumb that are undocumented but part of the domain narrative that is shared exclusively with members (Wenger, 1998).

Individuals become members of an occupational community of practice through participation in the community's activities, and by learning the appropriate work behaviours and norms (Bechky, 2003, p.317). Whilst it is often necessary to adapt such work behaviours to fit the specific organisational context or "locus of practice" (Betchky, 2003), occupational communities of practice shape their members' work activities in terms of how and why such activities are performed – "it is doing in a historical and social context that gives structure and meaning to what we do" (Wenger, 1998, p.47). User requirements are necessarily derived from their work practices. Thus it follows that the needs of ERP users who are members of occupational communities of practice are shaped by that community and by the shared practices and historical and social context within which those practices are conducted (Van Maanen & Barley, 1984).

4.4.2. Characteristics of OCoP Membership

Synthesis of the relevant literature identifies three characteristics of members of occupational communities that are relevant to this study (Bechky, 2003; Van Maanen & Barley, 1984; Wenger et al., 2002). These are occupational commitment, the need for self-control and subjective norm, discussed below.

4.4.2.1. Occupational Commitment (OCS)

Historically, commitment was studied within the domain of organisational behaviour. Meyer & Allen's (1991) synthesis of the extant literature on organisational commitment led to the development of a three-component model. This model identified three distinct dimensions of the construct, namely:

(1) Commitment as an affective attachment to the organisation, which they referred to as affective commitment;

(2) Commitment as a perceived cost associated with leaving the organisation, which they referred to as continuance commitment; and

(3) Commitment as an obligation to remain with the organisation, which they refer to as normative commitment.

More recently, interest in this concept has broadened to the domains of unions, professions, careers and occupations (Meyer et al, 1993). The terms occupation, profession and career have been used “somewhat interchangeably in the commitment literature” (Meyer, Allen, & Smith, 1993, p.539). For example, Wang et al suggest that “a profession is generally defined as an occupation requiring advanced education and specialist knowledge” (X. Wang & Armstrong, 2004, p.378). Meyer et al (1993) chose the term occupation over profession because they believed that both professionals and non-professionals can experience commitment to the work that they do.

For the purposes of this study, the definition of occupation is adopted from Lee et al, which is stated as “an identifiable and specific line of work that an individual engages in to earn a living at a given point in time (e.g., nurse, banker, clerk). It is made up of a constellation of requisite skills, knowledge, and duties that differentiate it from other occupations and, typically, is transferable across settings” (K. Lee, Carswell, & Allen, 2000, p.800).

Occupational commitment has been defined as "a person's belief in and acceptance of the values of his or her chosen occupation or line of work, and a willingness to maintain membership in that occupation" (Vandenberg & Scarpello, 1994, p.535). This definition implies a uni-dimensional view of the construct (Blau, 2001; Irving, Coleman, & Cooper, 1997; Meyer et al., 1993). However, Meyer et al (1993) believed that like organisational commitment, occupational commitment should be multi-dimensional in nature.

To this end, Meyer et al examined the applicability of their three-component organisational commitment model (1991) within the context of occupational commitment. Their study demonstrated that occupational and organisational commitment were distinct constructs, and that occupational commitment, like organisational commitment, should be operationalised in terms of the three components of affective, normative and continuance commitment. Empirical support for the generalisability of the model across occupations was also reported by Irving et al (1997).

Blau (2001, 2003) challenged the model, suggesting firstly that the continuance dimension be split into 2 further dimensions of accumulated costs and limited alternatives, and secondly, that the discriminant validity of the dimensions had not been appropriately established. Blau & Holladay (2006), however, concluded that a 1-factor measure for continuance commitment was in fact sufficient. Further, in support of Meyer et al's findings, whilst the other two dimensions appeared to depend interactively on each other, affective commitment was a 'stand alone' commitment dimension that demonstrated sufficient discriminant validity. Consequently, Meyer et al's (1993) model of occupational commitment is accepted for the purposes of this study.

Each of the three dimensions of occupational commitment implies a different reason for remaining in the chosen occupation. Members with a strong affective commitment will stay in their chosen occupation because they want to. In contrast, members with a strong continuance commitment will stay because they feel need to, and those with a strong normative continuance will remain because they feel obliged to do so (Meyer et al., 1993). In addition, commitment can vary in strength, from "somewhat bound to unconditionally bound" (Meyer & Herscovitch, 2001, p.318). The more committed the member, the more one would expect the member to display behaviours that reflect the community's practices, values and norms.

Occupational commitment thus refers to a member's sense of belonging to, or interdependence with, a community or collective (Koh & Kim, 2004). A strong occupational commitment results in high levels of self-control (see Section 4.4.2.2) and subjective norm (see Section 4.4.2.3) (Van Maanen & Barley, 1984; X. Wang & Armstrong, 2004).

4.4.2.2. Need for Self-Control

Occupational communities are founded on the belief that only the members possess the proper knowledge and skills required to decide on how the work is to be performed and assessed. Furthermore, members expect that they will dictate the entrance requirements to the community.

Although a job role is created within an organisation, the work that comprises such a role is generally linked to an occupational community. Members develop among themselves their own understanding of what their practice is about (Wenger, 1998), Differences between what management expect to be done and what is actually done are often the result of occupational members doing what they feel they must do, based on this understanding and historically developed shared practice (Van Maanen & Barley, 1984).

Thus, the organisation cannot autonomously control the work practice as the latter is shaped and regulated by the referent occupational community.

4.4.2.3. Subjective Norm

In the IS literature, the Subjective Norm has been identified as an important antecedent to a person's intention to use a technology (for example Ajzen, 1991; Fishbein & Ajzen, 1975; Taylor & Todd, 1995; Venkatesh & Morris, 2000), including ERP systems (Bagchi, Kanungo, & Dasgupta, 2003; Chung, Skibniewski, & Kwak, 2009; Elragal & Bhirry, 2011). It is defined as "a person's perception that most people who are important to him think he should or should not perform the behaviours in question" (Fishbein & Azjen, 1975, p 302). In mandatory settings, such as in the use of ERP systems, it has been reported that users will use a certain technology that they may not find to their liking if:

- they believe their important referents think that they should; and
- they are sufficiently motivated to comply with those referents (S. A. Brown et al., 2002; Venkatesh & Davis, 2000).

Within an occupational community context, members seek both support and affirmation to maintain a sense of belonging and identity and consequently select their referent others from the community (Van Maanen & Barley, 1984). Members look to their referent group for approval for their actions and work practices, including the use of technology (Taylor & Todd, 1995; Tulu et al., 2006; E. T. G. Wang et al., 2007). The appropriateness of a technology and its related work practices are often influenced by the opinions of community members (Tulu et al., 2006).

Thus, within the context of this study, subjective norm relates to the effect that referent others have on the motivation and attitude of members to accept technology-related work-practices.

4.4.3. OCoP Characteristics and ERP Success

Different communities of practice have different knowledge bases, rituals, and so forth (J. S. Brown & Duguid, 1991). Knowledge tends to leak in the direction of shared practices and sticks when practices are not shared (J. S. Brown & Duguid, 2001). People with different practices have different assumptions, world views, interpretations and ways of making sense of their world. In keeping with the Relativist philosophy underpinning this research (see section 6.2.2), it is argued that each person constructs their understanding of the world on the basis of their experiences with it (Bechky, 2003). ERP consultants and vendors have their own experiences, interactions, language, and so forth, and can be construed as comprising a distinct community of practice. Thus, the understandings that consultants and the other occupational communities that are part of the ERP implementation have may be different, causing the flow of knowledge between these communities to be sticky (Bechky, 2003; J. S. Brown & Duguid, 2001). This suggests that membership of different communities of practice could negatively influences the knowledge transfer barrier of shared understanding.

In addition, the three characteristics of members of occupational communities identified above may affect the knowledge transfer process

Occupational Commitment (OCS)

The three dimensions of occupational commitment each have different implications on the work behaviours and intentions of members. An attachment that is borne out of desire rather than need or obligation is a stronger and more naturally positive force (Blau & Holladay, 2006). Thus, members who are affectively committed are thus expected to identify more strongly with the community, and behave in ways that are beneficial to, and promote the community and its interests. In contrast, it has been found that continuance commitment has led to opposite behaviours (Meyer et al., 1993). This suggests that affective commitment could reduce member's willingness to accept knowledge from outsiders, thus negatively affecting the knowledge barrier of Motivation.

Further, this suggests that members who are affectively committed would be more likely to keep up with the latest developments in the occupation, through, for example, attending conferences, or participating in relevant associations (Meyer et al, 1993). Such members can be expected to have a high absorptive capacity in terms of work domain knowledge. Thus, affective commitment is seen to also positively affect the knowledge transfer barrier of Absorptive Capacity.

Need for Self-Control

The need for self-control emphasizes that work practices are regulated by members only and those members are resistant to changes originating from outside the community. Thus, attempts by organisations to impose outside practices, such as those embedded within an ERP system, will be met with resistance. In addition, members tend to be unwilling to share their specialist knowledge with outsiders as this sharing reduces their status and self-control (Van Maanen & Barley, 1984). Within an ERP implementation context, this suggests that members would be unwilling to precisely describe their work practices to ERP consultants, thus making communication more difficult.

Consequently, self-control can be seen to negatively affect the knowledge transfer barrier of motivation and enhance the arduousness of relationships between users and consultants.

Subjective Norm

The need for members to seek approval from their referent others suggests that subjective norm could negatively influence the knowledge transfer barriers of source credibility, unproven knowledge and motivation. Members may consider consultants to be outsiders and thus to be unreliable sources of acceptable and legitimate working practices. In addition, unless the technology itself is endorsed by referent others, or previously proven to be of use to other members, members would be unwilling to use the technology, that is, members' motivation to accept the technology would be negatively affected, and the technology would be considered to be unproven knowledge.

Thus, it is posited that the effects of occupational community of practice membership on ERP success is not a direct effect, but rather mediated through the effects of on the knowledge transfer barriers. These barriers, in turn, are posited to affect Work Practice Compatibility, which is identified as the primary antecedent of success.

4.5. Summary

In this chapter, it has been demonstrated that in order to enhance Work Practice Compatibility when implementing an ERP system, it is necessary to adapt either the system to suit the needs of the users, or the users' existing practices to suit the business model embedded in the system (Hong & Kim, 2002). This requires a bi-directional transfer of knowledge between the users and the implementation team.

It has also been shown that a major problem in ERP implementation is overcoming the barriers to effective knowledge transfer (Volkoff et al., 2004). Six barriers have been identified for investigation in this study, namely, Absorptive Capacity, Arduous Relationship, Motivation, Shared Understanding, Source Credibility, and Unproven Knowledge.

Review of the communities of practice literature identified that those users of ERP systems who belong to occupational communities of practice display characteristics that are enhanced by a strong sense of commitment to the community. These characteristics could have a significant impact on the stickiness of the knowledge transfer process, the ability of the members to adapt to new processes, and the level of resultant requirements mismatches that could be detrimental to ERP success. This suggests that a strong sense of commitment to the occupational community of practice (OCoP) could increase stickiness during the knowledge transfer process, thus having a detrimental effect on work practice compatibility and resultant overall implementation success.

Having reviewed the extant literature relevant to this research in the last three chapters, it is now possible to discuss the research model and hypotheses of this study. This is addressed in the following chapter.

CHAPTER 5

CONCEPTUAL MODEL AND HYPOTHESES

"Before beginning a Hunt, it is wise to ask someone what you are looking for before you begin looking for it."

Winnie the Pooh - Pooh's Little Instruction Book

5.1. Introduction

The previous three chapters explored the extant literature relevant to this research. Guided by this literature review, the propositions underpinning this research can now be explicated (5.2), followed by a presentation of the research statement (5.3),

The theoretical framework for this research is presented in section 5.4, which decomposes the research statement into a set of hypotheses. These hypotheses form the basis for the formulation of an overall research question, which in turn is decomposed into sub-questions (5.5). Section 5.6 concludes the chapter by assembling the hypotheses into the research model for this study.

5.2. The relationship between Occupational Community of Practice and Quality in Use

Based on the literature review discussed in the previous three chapters, this research is framed by the following propositions (1) increased job performance is achieved through system compatibility with work practices, (2) work practices are shaped by occupational communities of practices, (3) adaptation between the system and work practices is required during implementation, and (4) knowledge transfer, which is crucial for successful ERP implementation, is difficult and consists of many barriers that are exacerbated by OCoP characteristics

Collectively, these four propositions form the basis on which this research is based, namely that occupational communities of practice strength of commitment (OCS) will increase resistance to new knowledge and practices, thus interfering with the knowledge transfer process and reducing the ability of the consultants and users to mutually adapt the system to suit the users' needs in terms of existing, past, preferred and imposed working practices. This in turn will decrease the users' ability to achieve enhanced performance with the system. Thus, knowledge transfer barriers, adaptation and Work Practice Compatibility are intervening variables (Bryman & Bell, 2003) in the relationship between Occupational Community of Practice strength of commitment and Quality in Use.

5.3. Problem Statement

Based on the above, the following overall problem statement for this research can be derived:

> ERP systems ought to be compatible with Occupational Communities of Practice work practices in order to achieve the expected benefits of improved job performance

The associated sub-problems are as follows:

1. The relationship between occupational strength of commitment (OCS) and the barriers to the knowledge transfer process is not known
2. The relationships between adaptation, knowledge transfer barriers and work practice compatibility are not known
3. The relationship between work practice compatibility and self-perceived individual performance is not known

5.4. Theoretical Framework

The theoretical framework for this research study is based on the problem statement and sub problems listed above. Collectively, these problems suggest that investigating the problem of ERP success through the lens of occupational communities of practice could reveal an unidentified, and significant, explanatory factor of ERP adoption outcomes.

In the following sections, the hypotheses relating to each of these relationships are explicated

5.4.1. The Relationship between OCoP Commitment and Barriers

The implementation of an ERP system requires changes to existing working practices to a larger or lesser extent due to the necessity of having to adopt the Best practice processes embedded within the software. This occurs through a knowledge transfer process – ERP consultants need to transfer knowledge about the business processes embedded in the system to users who learn and apply this knowledge. Similarly, users will need to transfer knowledge to consultants who apply this knowledge by customising and/or configuring the system to better suit the requirements of the users. This knowledge transfer process is a lengthy and difficult process with many known barriers.

As discussed in the literature review, Szulanski (2003) identified a comprehensive framework for inter-firm transfer of knowledge. Prior research within the ERP context identified the relative importance of these barriers per phase of the knowledge transfer process (Ko et al., 2005; Timbrell et al., 2001). As the implementation phase is considered the most crucial phase of the process, only those barriers that were found to influence this phase are included in the research model and hypotheses (see Section 4.3.2).

Organisations employ staff members who belong to various Occupational Communities of Practice (OCoP). One of the characteristics that such members display is Occupational Commitment (OCS), which refers to one's sense of belonging to a collective (Koh & Kim, 2004). A strong sense of commitment results in high levels of self-control and subjective norm (Van

Maanen & Barley, 1984; X. Wang & Armstrong, 2004). A strong sense of commitment suggests that the member is more entrenched in the community and its accepted ways of working than members with a lesser sense of community.

Consequently it is expected that OCoP membership will strengthen these barriers, and further, that the higher the strength of occupational commitment (OCS), the stronger the barriers will be against outside interference. This expectation can be rephrased into the following general hypothesis:

H5 High levels of Occupational Community of Practice Strength of Commitment will affect the barriers to the knowledge transfer process

The anticipated effect of occupational community of practice membership and the strength of occupational commitment on each of the barriers relevant to the implementation phase of the knowledge transfer process are discussed next.

5.4.1.1. Absorptive Capacity

Being a member of an occupational community of practice suggests that the users have been through a training or apprenticeship programme that provides them with the knowledge base required to perform their jobs, as well as a shared language and knowledge about the most recent developments in their field (Park et al., 2007; Szulanski, 2003). This suggests that absorptive capacity of the new knowledge is enhanced, due to the training and prior knowledge that are acquired as part of becoming an established member of a community.

Thus, it is argued that a user's ability to understand the tasks and work processes that comprise their jobs can help them to understand the functionality and business process logic of an ERP system well enough to enable evaluation and utilisation of the system. Therefore, occupational community of practice members' knowledge stocks should be sufficient to enable evaluation and utilisation of new knowledge, both in terms of the work domain as well as in terms of the system domain. As discussed previously (see Section 4.4.3), it is expected that the higher the level of commitment to the community, the more likely the members will be to immerse themselves in the knowledge and keep up with latest developments.

Therefore it is posited that

H5-1 High levels of commitment will increase Absorptive Capacity of Work domain knowledge

H5-2 High levels of commitment will increase Absorptive Capacity of System domain knowledge

5.4.1.2. Motivation

Best practice processes are often ignored if they are considered to be foreign (Green, 2001). The processes embedded within an ERP system are industry Best Practice, not Best Practice originating from occupational communities of practice, and are therefore more likely to be viewed as foreign. In addition, OCoPs inherently resist changes to existing working practices that originate from outside the community – the Not Invented Here syndrome (Szulanski, 2003). Thus it can be argued that OCoP membership will reduce members' willingness to accept changes to their working practices originating from the new system. Further, the more committed the member is to the OCoP, the less willing they may be to learn and accept new knowledge from outside the community

Levels of motivation could be further reduced if members perceive the new technology to be a threat to their status (T. Klaus et al., 2007; Markus & Tanis, 2000). The implementation of an ERP system, which is designed to integrate and streamline processes, may be construed as an attempt to reduce the autonomy and status of occupational communities within the organisations. In these cases, such innovations will be resisted or even sabotaged (Timbrell et al., 2001; Van Maanen & Barley, 1984).

Therefore it is posited that

H5-4 High levels of commitment will decrease Motivation

5.4.1.3. Source credibility

Donors of the new knowledge are ERP vendors and/or the implementation team, both of which are considered to be outsiders from an OCoP perspective (Bechky, 2003). A strong sense of occupational commitment suggests that OCoP members will view these donors as unreliable sources of knowledge and working practices (Szulanski, 2003). Furthermore, as discussed in 4.4.2.3, members of an OCoP with a strong sense of community are more likely to have a high sense of subjective norm; thus the question of whether a particular software technology is appropriate and acceptable may be influenced by the opinions of the community at large, and in particular by those members that help to define and regulate the occupational practices (S. A. Brown et al., 2002; Venkatesh & Morris, 2000). Members with a strong sense of community are expected to be influenced more strongly by the recommendations of other members of the community. Therefore, the past successes or failures of the ERP system from the perspective of other members will substantially influence the credibility of the system, its vendors and its embedded work practices (Chau & Hu, 2001; Tulu et al., 2006). Thus it is posited that

H5-5 High levels of commitment will decrease Source Credibility

5.4.1.4. Unproven knowledge

Once again referring to the subjective norm, if the ERP system has not yet been widely implemented and used by members of the community in other organisations, there will be no proof of its acceptability, thus negatively influencing the effectiveness of the knowledge transfer process. Therefore it is hypothesized that

H5-6 High levels of commitment will increase the perceptions of Unproven Knowledge

5.4.1.5. Shared Understanding

Membership of an OCoP suggests specialised knowledge of the tasks, work practices and regulations that are regulated by the community of practice. The ways in which people actually work usually differs quite substantially from the descriptions of that work in manuals, training programs and job descriptions (J. S. Brown & Duguid, 1991). These descriptions do not take into account the specialist knowledge that is developed as a result of community membership and the locus of practice within which employees work. Because this knowledge is embedded within the context which gave rise to its use, it can never be fully explained (Van Maanen & Barley, 1984). This suggests that it is not possible for ERP developers to have an in depth understanding of the various functions' activities, but only a superficial understanding of what needs to be done.

Unless the ERP vendors and the implementers are themselves members of that community, it is unlikely that the source and the recipient will have shared work values, norms, philosophy, problem-solving approaches, and prior work experience, thus making knowledge transfer more difficult. Consequently, it is posited that

H5-7 High levels of commitment will decrease shared understanding between ERP users, vendors and implementers.

5.4.1.6. Arduous Relationship

Arduous relationship refers to the ease of communication between the users and the implementation team. The transfer of knowledge occurs through communication, and therefore the success of this transfer is dependent on the the "intimacy of the relationship" (Szulanski, 2003, p.31). Given the member's specialist knowledge of their job and tasks, as derived from their training and educational programs, it is expected that the higher the occupational commitment of the member, the less there will be a shared understanding of the "meaning of theories.... measures and accepted results" (Szulanski, 2003, p.31) between the user and the implementation team. In addition, members may be unwilling to share their specialist knowledge with the consultants because they may perceive this as reducing their status and self-control (Van Maanen & Barley, 1984). It can therefore be argued that Arduous Relationship reflects to some extent the level of shared understanding between users and the implementation team. Following this logic, it can similarly be reasoned that perceptions of unproven knowledge and source credibility, as well as the levels of motivation could be reflected in the level of Arduous Relationship. Thus it can be argued that Arduous Relationship is a multi-dimensional construct that is comprised of Shared Understanding, Unproven Knowledge, Source Credibility and Motivation. However, this proposition falls outside the scope of this study and will not be included in the research model.

Thus, it is hypothesized that

H5-3 High levels of commitment will increase arduous relationship

5.4.2. The Relationship between Barriers and Work Practice Compatibility

The extant literature suggests that work practice compatibility will be enhanced by the effectiveness of the knowledge transfer process. When knowledge is transferred successfully, users and the implementation team have a better understanding of the functionality and process models embedded in the package, leading to a better identification of the differences between existing, preferred and imposed work practices and the processes embedded in the system, This in turn should lead to more effective customisation and/or organisational change initiatives, resulting in a better fit between the system functionality and the user requirements, that is, higher levels of perceived work compatibility.

The literature further suggests that interdependencies exist between the barriers, and specifically, that there is a relationship between Motivation and the other barriers. This relationship can be argued for in both directions, as discussed in section 4.3.2.5.

For parsimonious purposes, and to decrease the complexity of the model, it is therefore posited that all barriers will affect Motivation and Motivation will have an effect on work practice compatibility, thus

H3-1 Decreased Motivation will decrease perceptions of Compatibility with Existing Practices

H3-2 Decreased Motivation will decrease perceptions of Compatibility with Imposed Practices

H3-3 Decreased Motivation will decrease perceptions of Compatibility with Preferred Practices

The expected effects of the barriers to the knowledge transfer process on Motivation, within the context of occupational communities of practice are discussed next

5.4.2.1. Absorptive Capacity

Absorptive Capacity refers to a user's ability to understand and apply new knowledge based on their prior stocks of knowledge. As discussed in the literature review, effective knowledge transfer consists of understanding, as well as internalisation, of the new knowledge. The recipient's stock of prior knowledge is largely shaped by the community of practice's work processes and signature processes that were developed over time to accommodate the unique requirements of the organisation. Thus it can be argued that unless the new knowledge from external sources is well aligned to this prior knowledge, a high absorptive capacity of the members could result in an evaluation of a poor fit between the system functionality and the member's task requirements. As noted by Brown and DuGuid (2001), the capacity to assimilate new knowledge is not just about intelligence, but is also influenced by the way in which the relevant discipline or profession or organisational context shapes the outlook of the individuals. For example, Tulu et al (2006) reported that within a medical professional community of practice context, a physician's self perceived professional role may or may not appear to be compatible with a particular set of technology-based work practices, particularly when peer recommendations are involved in the choice of medical information technologies.

This issue is particularly relevant when there is a strong occupational commitment and the system requires work practices in conflict with the accepted working practices of the OCoP. Therefore, whilst Absorptive Capacity has a positive effect on knowledge transfer, it can equally have a negative impact on perceived work compatibility.

Within an OCoP context therefore, it is possible that enhanced absorptive capacity would result in a better understanding of the ERP business model and processes, and their implications in terms of imposed (regulated), existing and preferred working practices. Should this enhanced understanding result in the identification of misfits between the processes provided by the system and those required by the community of practice, members may be unwilling to accept the system. Therefore, it is posited that

H4-1 Increased Absorptive Capacity of System domain knowledge will decrease Motivation

H4-2 Increased Absorptive Capacity of Work domain knowledge will decrease Motivation

5.4.2.2. Source credibility

Source Credibility is the degree to which the donor of the Best Practice is perceived to be reliable and trustworthy (Gefen, 2004; Szulanski et al., 2004). Based on this definition, it makes sense to suggest that the lower the perception of donor reliability, the lower will be the users' motivation to learn the new knowledge being offered. Therefore, it is posited that

H4-4 Increased Source Credibility will increase Motivation

5.4.2.3. Shared Understanding

Shared Understanding is defined as the similarity in the source and recipient's work values, norms, philosophy, problem-solving approaches, and prior work experience (Ko et al., 2005). Within an ERP and OCoP context, a low Shared Understanding (SU) highlights the fact that the ERP implementation team are outsiders to the OCoP (Soh et al., 2000), thus enhancing the resistance of the members to accepting knowledge from outside, ie exacerbating the Not-Invented-Here syndrome. This would suggest that a low SU negatively influences Motivation. Thus it is posited that a shared understanding between the recipient and the source can enhance motivation as it suggests a closer relationship between the source and the recipient, in other words, that the source is not seen as so much of an outsider. Therefore, it is posited that

H4-6 Increased Shared Understanding will increase Motivation

5.4.2.4. Unproven knowledge

Unproven knowledge refers to whether the knowledge being transferred has been previously proven to be of use by others (Szulanski, 2003). Unproven knowledge makes it more difficult to persuade potential recipients to accept the knowledge transfer and the accompanying technology (Rogers, 1983). Once again, this suggests that unproven knowledge will have an impact on the users' willingness to learn the new knowledge. In addition, it can also be argued that the more useful the knowledge has been proven to be, the more credible the source will be viewed. Therefore, it is posited that

H4-5 Increased Unproven Knowledge will decrease Motivation

5.4.2.5. Arduous Relationship

As discussed above, arduous relationship refers to the ease of communication between the user and the implementation team. Difficulties experienced with communications would make it more likely that users become unwilling to cooperate and communicate their needs and ideas with the implementation team. Therefore it is posited that

H4-3 Increased levels of Arduousness in the Relationship between the implementation team and the end users will decrease Motivation

5.4.3. The Relationship between Work Practice Compatibility and Quality in Use

Quality in use relates to the benefits that are realised as a result of system use. From a user perspective, these benefits refer to enhanced task performance, such as increased speed, ease of task execution and increased task effectiveness. Quality in use requires a good fit between the user, the task and the technology, that is, quality in use requires that the system is compatible with users' work practices.

As discussed in Chapter 2, the construct of Work Practice Compatibility employed for this study is defined similarly to that proposed by Karahanna et al (2006), but with the understanding that the construct includes the needs of users.

Karahanna et al (2006) identified four sub-dimensions of compatibility, namely (1) compatibility with existing work practices, (2) compatibility with preferred work practices, (3) compatibility with values, and (4) compatibility with prior experience. Within an OCoP context, it is argued that the compatibility with values sub-dimension be redefined to emphasize the referent community of practice values. The prior experience dimension relates to prior experience with technology and is therefore considered to be subsumed by the Absorptive Capacity of System domain construct and is therefore excluded from the compatibility construct. Thus it is posited that

H1 Increased perceptions of Compatibility with Work Practices will positively influence the perceptions of enhanced job performance.

From a theoretical perspective, Moore and Benbasat suggest that there could be a relationship between compatibility and quality in use: "it is unlikely that respondents would perceive the various advantages of using a PWS (personal work station), if its use were in fact not compatible with the respondent's experience or work style" (1991, p.208). This experience or work style can be viewed as users' current working practices. Further theoretical support for this notion was derived from the usability literature: maintaining consistency with existing practices means that users do not have to go through a substantial learning curve resulting in increased time, effort and mistakes when using the system initially (Dix et al., 2004; Grudin, 1989). Therefore, innovations that fit well with existing practices have been shown to lead to enhanced job performance in terms of increased speed, accuracy and ease of task execution (for example Compeau, Meister, & Higgins, 2007; Karahanna et al., 2006; Sun et al., 2009).

From an OCoP perspective, this is even more important: as discussed in chapter 3, members of an occupational community of practice tend to have strong resistance to outside interference, and therefore perceived changes to existing ways of working would not be willingly accepted. Consequently it is posited that

H1-1 Increased perceptions of Compatibility with Existing Practices will positively influence the perceptions of enhanced job performance

People tend to want to behave in ways that are consistent with their deeply held values (Compeau et al., 2007). The stronger the commitment to their OCoP, the more the OCoP shapes their values. This suggests that technologies that are consistent with the practices imposed by occupational communities of practice are likely to be perceived as being consistent with members' referent value systems, thereby contributing to increased perceptions of compatibility (Compeau et al., 2007; Karahanna et al., 2006; Moore & Benbasat, 1991). Therefore it is posited that

H1-2 Increased perceptions of Compatibility with Imposed Practices will positively influence the perceptions of enhanced job performance

Compatibility with Preferred Practices has been shown to be strongly related to benefits of use in previous research (Agarwal & Prasad, 2000; Karahanna et al., 2006; Moore & Benbasat, 1991) It has been suggested that the reason for this is because individuals would believe that a technology would provide them with better job performance if they believe it will be compatible with how they would prefer to work, given the choice (Compeau et al., 2007). This notion is supported by Venkatesh and Davis (2000) who hypothesize an influence of job relevance which they liken to compatibility. This relationship is also supported by Chau and Hu (2001) and Chen (2002).

Within an OCoP context, an individual's preferred work style is likely to be consistent with his or her values, particular in terms of the work practices stemming from a referent OCoP. Therefore it is posited that

H1-3 Increased perceptions of Compatibility with Preferred Practices will positively influence the perceptions of enhanced job performance

5.4.4. The Relationship between Adaptation and Work Practice Compatibility

As discussed in Section 4.2, to enhance Work Practice Compatibility when implementing an ERP system, it is necessary to (1) adapt the system to suit the needs of the users (system adaptation), (2) adapt the users' existing practices to suit the business model embedded in the system (process adaptation), or (3) engage in a combination of both process and system adaptation (Hong & Kim, 2002; Law & Ngai, 2007; Markus et al., 2000; Sia & Soh, 2007).

Regardless of which method is chosen, the objective of the adaptation process should be to align the system's embedded processes with the needs of the users (Gefen, 2004; Savage et al., 2010; E. T. G. Wang et al., 2007).

The impacts of process adaptation and system adaptation on work practice compatibility have been considered in many studies. For example, Hong & Kim (2002) found empirical evidence that both process and system adaptation had moderating effects on the relationship between the organisational fit of an ERP system and the success of its implementation. Similarly, Law and Ngai (2007) reported that companies were engaging almost equally in both process adaptation (70% of respondents) and system adaptation (68% of respondents) as a means of achieving ERP business process fit.

However, it is posited that within an OCoP context, process adaptation initiatives could negatively affect Work Practice Compatibility, while system adaptation initiatives could positively affect Work Practice Compatibility. Process adaptation requires a collaborative effort between the users and the implementation team; users need to provide information about existing work practices and the team needs to provide suggestions on how these existing practices can be adapted to better suit the system's embedded functionality (see Section 4.3). However, OCoP membership reduces members' willingness to accept changes to their working practices that originate from outside the community (see Section 5.4.1.2). This may cause members to be unwilling to share the required information about their working practices, or to collaborate effectively during the process adaption initiative that is necessary for the successful redesign of working practices.

In contrast, it is expected that community of practice members will be cooperative and supportive of changes to the system to accommodate their working practices. Thus it is posited that:

H2 Adaptation will affect perceptions of Work Practice Compatibility

Specifically:

H2-1 Process adaptation to suit the Best Practices embedded within the system will decrease perceptions of Compatibility with Existing Practices.

H2-2 Process adaptation to suit the Best Practices embedded within the system will decrease perceptions of Compatibility with Imposed Practices.

H2-3 Process adaptation to suit the Best Practices embedded within the system will decrease perceptions of Compatibility with Preferred Practices.

H2-4 System adaptation to suit existing work practices will enhance perceptions of Compatibility with Existing Practices.

H2-5 System adaptation to suit imposed work practices will enhance perceptions of Compatibility with Imposed Practices.

H2-6 System adaptation to suit preferred work practices will enhance perceptions of Compatibility with Preferred Practices.

5.4.5. The Relationship between Adaptation and Barriers

Members of occupational communities of practice inherently resist changes to existing and accepted working practices. Therefore, it is reasonable to expect that if the system is adapted to comply with the community's accepted practices, members will be more willing to accept the system. In contrast, it is also reasonable to expect that if adoption of the system is perceived to require working practices that conflict with accepted or regulated working practices, members' willingness to accept the system will be reduced. Thus, it is hypothesized that:

H6-1 Process adaptation to suit embedded Best Practices will decrease Motivation

H6-2 System adaptation to suit user requirements will increase Motivation

5.5. Research Question

The theoretical framework as outlined above has resulted in the formulation of the following overall research question:

> To what extent do variances in Occupational Communities of Practice Strength of Commitment explain ERP Implementation Success, as measured in terms of Self-Perceived Individual Performance?

This question is decomposed into the following three sub-questions for ease of operationalisation and focus:

1. What is the relationship between OCoP Strength of Commitment and the barriers to the knowledge transfer process?

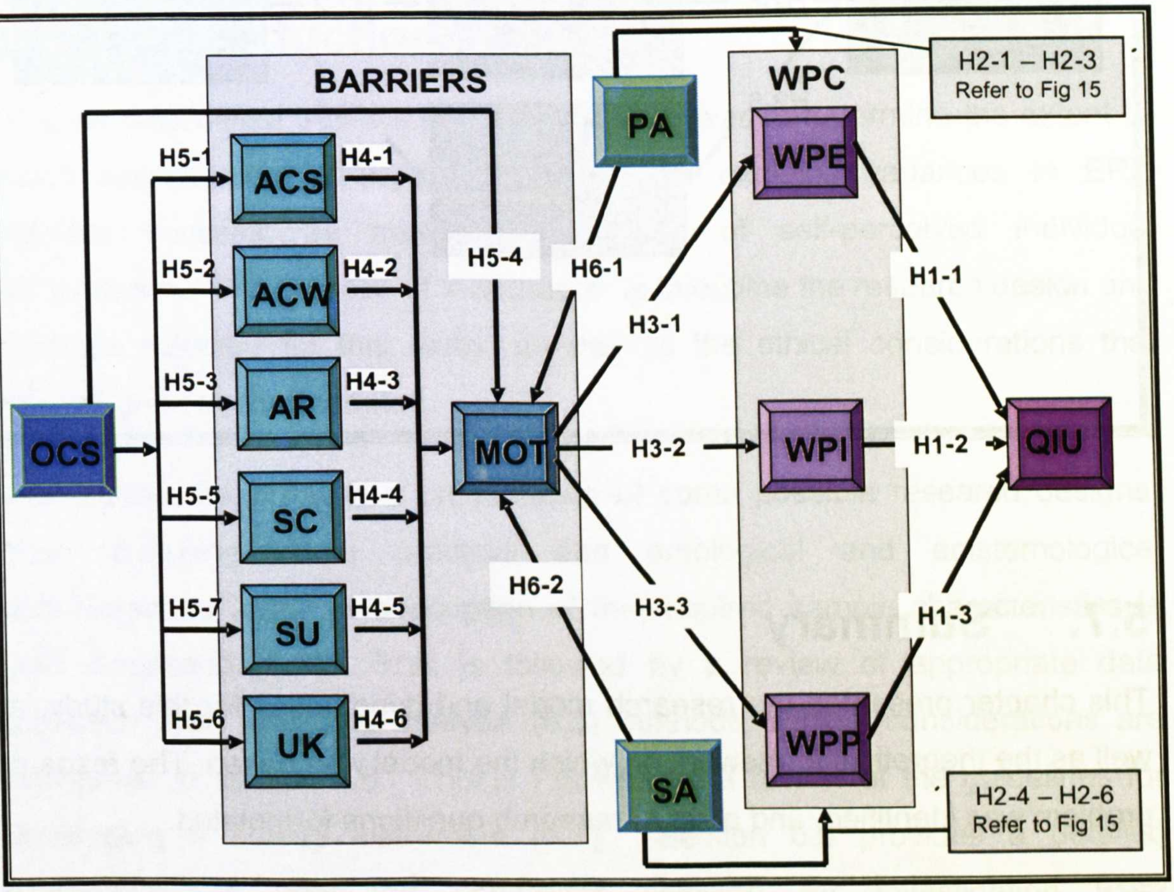
2. What is the relationship between system / organisational adaptation, barriers to the knowledge transfer process, and Work Practice Compatibility?

3. What is the relationship between Work Practice Compatibility and self-perceived job performance?

5.6. Research Model

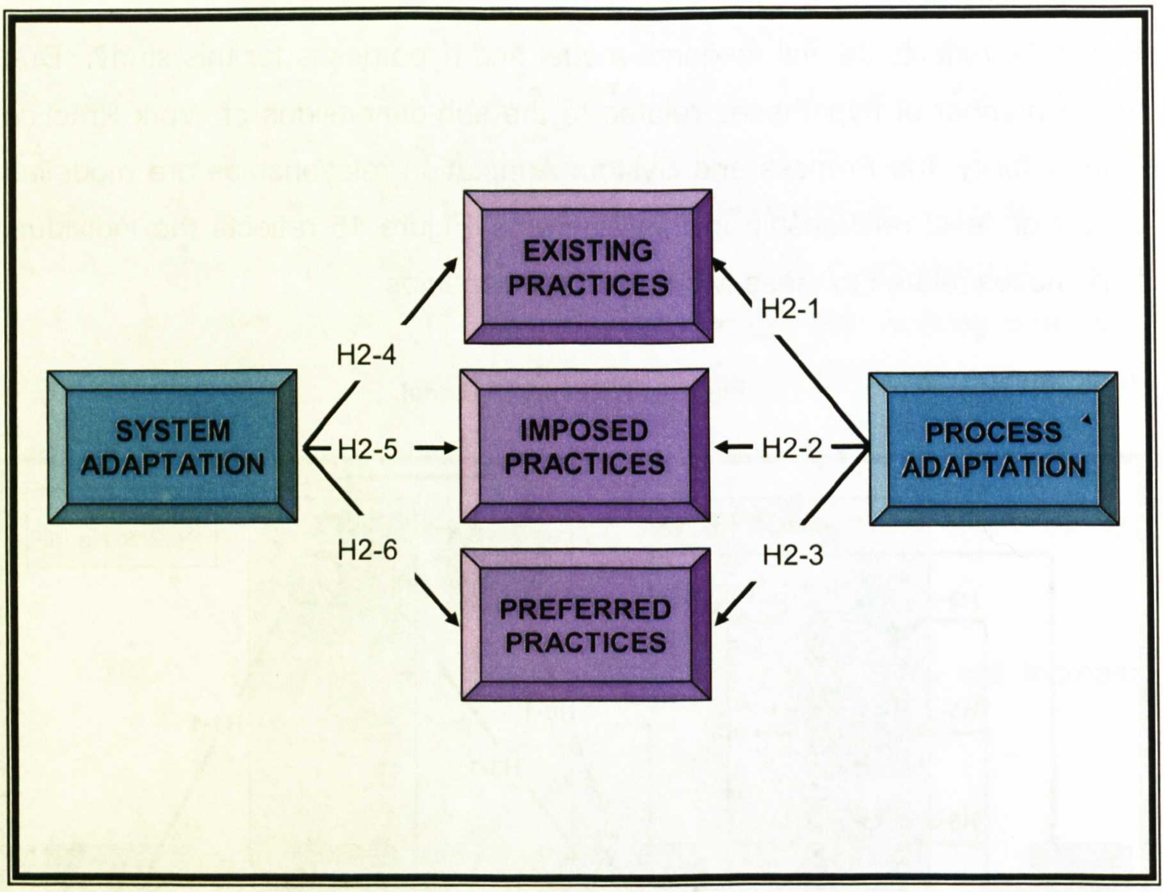
Figure 14 reflects the full research model and hypotheses for this study. Due to the number of hypotheses related to the sub-dimensions of Work Practice Compatibility, the Process and System Adaptation relationships are modelled as a high-level relationship in this diagram. Figure 15 reflects the individual hypotheses related to these two sets of relationships.

Figure 14: Research Model



Key:
ACS = Absorptive Capacity Work Domain Knowledge; ACW = Absorptive Capacity System Domain Knowledge; AR = Arduous Relationship; MOT = Motivation; PA = Process Adaptation; QIU = Quality in Use; SA = System Adaptation; SC = Source Credibility; SU = Shared Understanding; OCS = Occupational Community of Practice Strength of Commitment; WPE = Compatibility with Existing Practices; WPI = Compatibility with Imposed Practices; WPP = Compatibility with Preferred Practices; UK = Unproven Knowledge

Figure 15: Research Model: Hypothesized Relationships between Adaptation and WPC



5.7. Summary

This chapter presented the research model and hypotheses for this study, as well as the theoretical framework on which the model was based. The research problem was identified, and a set of research questions formulated.

The research design and methods and techniques selected to investigate the research model and answer the research question are addressed in the following chapter.

CHAPTER 6

RESEARCH DESIGN

Piglet: 'Pooh?' Pooh: 'Yes, Piglet?' Piglet: 'I've been thinking...' Pooh: 'That's a very good habit to get into, Piglet.'

Winnie the Pooh – The House at Pooh Corner

6.1. Introduction

Chapter 5 identified that the research problem was to determine the extent to which occupational strength of commitment explains variances in ERP systems success, as measured in terms of self-perceived individual performance. The purpose of this chapter is to outline the research design and methods selected for this study, as well as the ethical considerations that needed to be accommodated.

The chapter begins with a presentation of some possible research designs, after reviewing some practical and ontological and epistemological considerations (6.2). A description of the required sample characteristics is then discussed (6.3). This is followed by a review of appropriate data collection (6.4) and data analysis (6.5) methods. Ethical considerations are addressed in section 6.6. This is followed by a review of the guidelines for developing a survey instrument (6.7). Section 6.8 provides a detailed explanation of how the constructs selected for investigation were operationalised.

6.2. Research Design

Two issues should be taken into consideration when selecting appropriate research strategy and design (1) epistemological and ontological considerations, and (2) practical considerations (Bryman & Bell, 2003; Easterby-Smith, Thorpe, & Lowe, 2006)

6.2.1. Practical Considerations

The choice of research design, methods and techniques for this study was influenced to a large extent by the practicalities of obtaining the required data.

Industry collaboration had been secured with a global software implementation consulting company (ConCo) that specialises in ERP systems, who had undertaken to secure participation in this study from their customers. Due to customer confidentiality policies, ConCo's collaboration was conditional on such participation occurring through a web-based survey instrument that could be completed and returned anonymously by the user.

Given ConCo's extensive client base, and the large numbers of users that many of its clients comprised, it was envisaged that sufficient responses would be obtained to enable a more granular approach to answering the research question. Specifically, the main study was designed to enable analysis of the following:

- Any differences in levels of perceptions of ERP success between different occupational communities of practice, for example, would accounting and finance users have higher levels of perceived usefulness than marketing and sales users?
- Any difference in levels of difficulty during the knowledge transfer process as a result of differences in occupational communities of practice, for example, would accounting and finance users be more resistant than human resources users?
- The effect of the amount of time that users had been using the new system on user perceptions of work practice compatibility and usefulness. For example, would users eventually become used to the new system and either regain or surpass their previous levels of productivity, and how long would it take to reach these levels?
- The effect of different categories and types of ERP systems in terms of barriers, perceptions of work practice compatibility and/or perceived

usefulness, for example, are Tier I systems generally perceived to be more or less useful than Tier II or Tier III systems?

- The extent to which the length of tenure or length of time in a particular line of work affects the levels of difficulty during the knowledge transfer process, perceptions of work practice compatibility and/or perceptions of usefulness. For example, would a user who has been working in the same job for 10 years be more resistant to the adoption of a new system than someone who has only been in that job for 2 years?

As ConCo's collaboration was deemed invaluable to this study in terms of acquiring the necessary data from participants with the required characteristics, it was agreed to meet their condition as stipulated.

Consequently, a survey research design was chosen coupled with the use of a questionnaire for data collection and quantitative methods for data analysis. The choice of design and related methods are compatible with other similar studies performed within the IS and Management disciplines (for example Compeau et al., 2007; Karahanna et al., 2006; Ko et al., 2005)

As discussed in the following section, a review of research philosophies supports the choice of research design and methods.

6.2.2. Ontological and Epistemological Considerations

Epistemological and ontological considerations, together with research strategy decisions form the basis for research design decisions in both management research (Easterby-Smith et al., 2006) and business research (Bryman & Bell, 2003). Ontology refers to the assumptions that one makes about the nature of reality, whilst epistemology refers to a general set of assumptions that one makes about the best ways of enquiring into that reality (Easterby-Smith et al., 2006). Thus, the methods selected for data collection and analysis should reflect the characteristics of the ontological and epistemological position of the researcher.

The focus of the social sciences is people and their institutions, and therefore management and business research ontologies and epistemologies draw from the social sciences. Numerous ontologies and epistemologies exist in the social science research arena; with different authors presenting different taxonomies (for example Bryman & Bell, 2003; Easterby-Smith et al., 2006), resulting in conflicts and confusions (Bryman & Bell, 2003). The taxonomy presented by Easterby-Smith (2006) will be used as a framework for purposes of this research and this discussion.

For social science research, there is a core debate that is epitomized by the characteristics and implications of Positivism and Social Constructionism, which are at opposite sides of the epistemological spectrum and are thus in direct opposition to one another. In essence, Positivism is characterised by the view that the world is objective and external to oneself, whilst Social Constructionists hold the belief that reality is socially constructed and given meaning by people. The implications on the research process of these two opposing beliefs are summarised in Table 8.

Table 8: Contrasting implications of Positivism and Social Constructionism
(Source: (Easterby-Smith et al., 2006, p.30))

	Positivism	Social Constructionism
The Observer	Must be independent	Is part of what is being observed
Explanations	Must demonstrate causality	Aim to increase general understanding of the situation
Research progress through	Hypothesis and deduction	Gathering rich data from which ideas are induced
Concepts	Need to be operationalised so they can be measured	Should incorporate stakeholder perspectives
Generalisation through	Statistical probability	Theoretical abstraction
Sample required	Large numbers selected randomly	Small number of cases chosen for specific reasons

A third main approach encompassing epistemology and ontology in the social sciences is Relativism (Easterby-Smith et al., 2006), and is closely associated to Positivism. Whilst positivism relies on the design of experiments to precisely measure key factors in order to test predetermined hypotheses, relativism takes into consideration the practical difficulties of gaining direct access to reality. This means that relativist research will usually make use of a triangulation of methods, and by surveying viewpoints and experiences of large samples of individuals. In addition, whilst Positivist researchers expect their research to result in identification of causality, Relativist researchers believe that it is only a matter of probability that the views collected will provide an accurate indication of the situation, and the expected outcomes are correlations rather than definitive causality. The differences between the three epistemologies are summarised in Table 9.

Table 9: Methodological implications of epistemologies within social science
(Source: (Easterby-Smith et al., 2006, p.34))

	Positivism	Relativism	Social Constructionism
Aims	Discovery	Exposure	Invention
Starting Points	Hypothesis	Supposition	Meanings
Designs	Experiment	Triangulation	Reflexivity
Techniques	Measurement	Survey	Conversation
Analysis / Interpretation	Verification / Falsification	Probability	Sense-making
Outcomes	Causality	Correlation	Understanding

The ontological and epistemological positions underlying this research need to be chosen in terms of its context and of the entities that are being investigated. To answer the research question it was necessary to collect data on user perceptions. Perceptions are a belief-based construct because they are shaped by values, experiences and knowledge. This suggests that each individual views reality in a different way and constructs their own subjective reality in their minds, which is shaped by their own individual belief structure that in turn is based on their values, beliefs and knowledge. Thus it could be argued that, from a management or business perspective, the underlying ontological position of the current research is that meaning is socially constructed, and therefore human behaviour can only be understood through understanding the socially-constructed meanings that people give to particular phenomena. .

However, technology is viewed as a socio-technical system, meaning that work systems are composed of both human and technological elements, and that the interaction of people (a social system) with tools and techniques (a technical system) should be the central issue. Thus, in contrast to the technological determinism view that was prevalent in the early twentieth century which advocated that social change, including changes in organisations and work is primarily dictated by technology, the socio-technical view is that technology shapes, and is shaped by, its users (Emery & Trist, 1960; C. J. Stefanou, 2002; Trist, 1981) This view of technology in organisations suggests that the system itself is an objective entity that has a reality external to social actors. The impacts that the system has on its users are dependent on a variety of user characteristics, including their prior knowledge, experiences and beliefs. However, these impacts are also objective entities, and the goal of information systems research in this instance is to identify the key user characteristics that influence these impacts.

Consequently, based on the philosophical frameworks discussed above, Relativism is deemed the most appropriate ontological and epistemological position for this research because

- It is not possible to conduct a true experiment as required by the Positivist approach. In order to conduct an experiment it is necessary to be able to manipulate the independent variable(s) to be able to establish whether or not it has an effect on the dependent variable (Bryman & Bell, 2003; Hair et al., 2003). However, in the case of this study, as is the case for most management research, the independent variables under investigation cannot be manipulated (Bryman & Bell, 2003). In contrast, the Relativist approach makes use of correlational research which observes the co-occurrence of variables to determine whether there is a correlation between the variables (Field, p 15), which can be achieved in the context of this study.

- It is the researcher's world view that there is a reality that exists external to social actors, but that individuals may understand that reality differs based on the meanings that they ascribe to it, based on their own beliefs, values and experiences.

The primary data collection method used in a relativist approach to research is the survey, as reflected in Table 5 above. Given the need to obtain data from users representing different ERP systems (see section 6.3 below), it was necessary to obtain a large sample from different organisations: such a study is referred to as a cross-sectional survey (Bryman & Bell, 2003; Easterby-Smith et al., 2006). Due to the large number of data that would be generated from such a wide sample, a quantitative approach to the analysis deemed most effective, and consequently a questionnaire-based survey was considered more appropriate than an interview-based survey.

Thus, from a research philosophy perspective, it is demonstrated that the use of a survey, coupled with a questionnaire and quantitative analysis methods, is appropriate for this research context.

6.3. Sampling

It was necessary to collect data from a large, diverse pool of actual ERP end-users to effectively conduct this study. No specific job title, location or system was required for the purposes of this study; the primary requirement was that the respondent was a bona fide end-user of a recognised ERP system of any kind. Other respondent characteristics that were required included the following: participants should

- have been involved in the implementation process
- have been in the same job pre- and post-implementation to be able to judge the extent to which the system is compatible with existing working practices
- be representative of all levels of the organisation, that is, from top management through to operations, to avoid biasing the results based on the views of a single organisational level.
- be representative of different occupational communities of practice, to control for the possibility that some systems may be more compatible with specific occupational communities than with others (see section x)
- be a mix between genders

- belong to differing age groups
- have used the system for different periods of time, to control for differences in levels of experience with the technology which could distort results (see section 3.3.1)

In addition, it was important that a diverse range of ERP systems were represented by the sample to avoid biasing the results in favour of a single vendor.

As all of the above requirements could be met using the clients of the collaboration company ConCo, it was intended to restrict the sample population to their clients. However, one week before the main study was due to be implemented, ConCo reneged on their collaboration agreement, citing customer confidentiality and data protection policies as their reasons. As a result, the intended data collection method had to be revised.

Numerous alternative collection methods were explored, the details of which are described in Section 9.2. The overarching method used was social networking, thereby considerably extending the sample population. Limitations of the use of this method, the associated potential problems and the mechanisms put in place to limit these problems, are also described in Section 9.2.

6.4. Data Collection

Two data collection phases were undertaken: the first phase involved collecting pilot study data, the second collected data for the main study. Online questionnaires were developed specifically for the purposes of this study; the development of the pilot study research instrument is discussed in detail in section 6.7 and the revisions required for the main study instrument are described in section 8.2.

Both on-line surveys were hosted by the web-based survey company Survey Monkey (www.surveymonkey.com). Access to the pilot study was done via the Information Systems department of the company that agreed to participate in the pilot study. Access to the main study survey was through links provided on appeals posted on various social networking groups, emailed to various related organisations and individuals, and posted on web-based articles (see Section 9.2 for more details).

For both the pilot and main studies, data were collected about ERP end-users'

- commitment to their occupational community of practice;
- involvement in the implementation of the system;
- perceptions of the system implementation team and their relationship with them;
- perceptions of system compatibility with job needs; and
- perceptions of the impact of the system on their job performance.

6.5. Data Analysis

Data analysis was carried out on two separate sets of data, namely the pilot study data set and the main study data set. The objective of the pilot study data set analysis was to test the reliability and validity of the research instrument, so that any weaknesses found could be removed prior to the administration of the main study.

The main study data was analysed in order to answer the research questions. This analysis required two phases: firstly it was necessary to re-assess the validity of the research instrument as it had been revised in order to eliminate the weaknesses identified during the pilot phase; thereafter the research model and hypotheses could be tested.

6.5.1. Selection of Quantitative Analysis Techniques

Statistical methods used to test hypotheses can be categorized into three types, namely univariate, bivariate and multivariate (Hair et al., 2003). The choice of a particular statistical technique is dependent on the type of measurement used (as discussed in section 6.7.2) and the number of variables examined simultaneously.

Univariate statistics can only assess a single variable, while bivariate statistics can assess two variables. In contrast, multivariate statistics can assess many variables at the same time, including dependent and independent variables (Bryman & Bell, 2003; Field, 2009). Frequency tables are an example of an univariate analysis technique, Simple linear regression and one-way ANOVA are examples or bivariate analysis techniques; and multiple regression, factor analysis and MANOVA are examples of multivariate techniques. These techniques, also referred to as first-generation techniques, can be used to test theoretical hypotheses based on the analysis of empirical data.

6.5.1.1. Factor Analysis

Factor analysis (FA) refers to a set of statistical techniques that is used to identify a groups or clusters of variables (Field, 2009, p.628). This set of techniques has three main uses: (1) to understand the structure of a set of variables, (2), to develop a questionnaire to measure one or more unobservable variables, and (3) to reduce the number of variables under investigation to a more manageable size while retaining as much of the original information as possible.

There are two main categories of factor analysis, namely Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA).

EFA is used for questionnaire design and data reduction. For example, a researcher may not have any idea as to how many underlying dimensions there are for a given data set. EFA can be used as a way of determining the minimum number of hypothesized factors that can account for the observed covariation, thus at the same time reducing the number of variables that are required to investigate specific constructs. On the other hand, CFA is used for hypothesis testing – for example, identifying the relationship structures between variables (Field, 2009), or for testing which variables belong to a particular dimension (construct) (Kim & Mueller, 1978). Therefore, CFA is a means of confirming hypotheses, either about correlations between dimensions, or about which variables reflect those dimensions. EFA is a means of exploring the fit between variables and dimensions, without an a priori hypothesis guiding the process.

The distinction between CFA and EFA is not always straightforward. For example, when validating questionnaires, a researcher may use CFA or EFA as a means of checking the meaning of one or more variables, by determining which variables load onto which factors.

6.5.1.2. PLS-SEM

First-generation techniques, such as Factor Analysis, have three limitations, namely

- The assumption that all variables can be considered as observable - in most business and management research, very few of the variables under investigation can be considered as observable, such as age and gender. The majority of variables, however, are unobservable, particularly those relating to opinions and attitudes.

- The need for a simple model structure, which is particularly unlikely when there, is a need to investigate the potential effect of mediating or moderating variables on the relationship between one or more dependent and independent variables.

- The sample size – there is some debate on the minimum sample size required for Factor Analysis, Traditional recommendations include absolute sample sizes (ranging from 200 to 1000) and number of cases per variable (ranging from 3:1 to 6:1) (de Winter, Dodou, & Wieringa, 2009)

Structural equation modeling (SEM) is a technique that has become quite prevalent as a way of overcoming the limitations of first-generation techniques (Esteves, Casanovas, & Pastor, 2003; Haenlein & Kaplan, 2004). Firstly, the testing of structural relationships between unobservable variables can be accommodated (Long, 1994). This set of techniques allows the researcher to construct unobservable (latent) variables that are measured by indicators (also called items, manifest variables or observed measures), thus allowing the researcher to "statistically test a priori substantive/theoretical and measurement assumptions against empirical data (i.e. confirmatory analysis)" (Chin, 1998a, p.vii).

In general, there are two approaches to SEM, namely the covariance-based approach and the variance-based (or components-based) approach. Covariance-based SEM (CB-SEM) "attempts to minimize the difference between the sample covariances and those predicted by the theoretical model....Therefore, the parameter estimation process attempts to reproduce the covariance matrix of the observed measures" (Chin & Newsted, 1999, p.309). The most common tool used to perform covariance-based SEM is LISREL, the program developed by Jöreskog in 1975 (Jöreskog, 1982), and consequently the term LISREL is often used as synonymous for covariance-SEM (Haenlein & Kaplan, 2004).

In contrast, variance-based SEM focuses on maximizing the variance of the dependent variable(s) explained by the independent ones (Hair, Ringle, & Sarstedt, 2011). Partial Least Squares Structural Equation Modeling (PLS-SEM) is the most well-known instance of variance-based SEM, and has become the approach most widely used in marketing and business research (Hair et al., 2011; Henseler, Ringle, & Sinkovics, 2009), and in particular, for success factor studies in marketing (Henseler et al., 2009). PLS-SEM is conceptually and practically similar to multiple regression analysis in that the primary objective is to maximize explained variance in the dependent variable; however, unlike multiple regression, PLS-SEM also makes it possible investigate the reliability and validity of the measures at the same time (Hair et al., 2011; Henseler et al., 2009).

Generally speaking, the theoretical differences between PLS-SEM and CB-SEM are quite straightforward: if the objective of the research is theory testing and confirmation, then CB-SEM should be used. If, however, the research seeks to generate theory and be predictive, then PLS-SEM is the most appropriate approach to follow. Nevertheless, there are many conditions under which PLS-SEM can be selected for theory testing and confirmation, the most relevant of which are listed below[3]:

- When the sample size is inadequate for CB-SEM

The minimum sample size for PLS-SEM is the larger of either (1) 10 times the largest number of structural paths directed at a particular latent construct in the model, or (2) ten times the largest number of formative indicators used to measure one construct (Haenlein & Kaplan, 2004; Hair et al., 2011). In contrast, CB-SEM requires a minimum of 100 observations, with 200 observations being preferable to avoid results that cannot be interpreted (Haenlein & Kaplan, 2004).

- When the structural model is complex, that is, there are many constructs and many indicators (Chin & Newsted, 1999; Esteves et al., 2003)

6.5.1.3. Selection of Analysis Techniques

As noted above, the objective of the pilot study was to validate the questionnaire in terms of the measures used for each of the constructs. Consequently, CFA was selected for this purpose as no structural relationship analyses were required, and the sample size was adequate to meet the minimum requirements (de Winter et al., 2009; Sapnas & Zeller, 2002).

However, for the main study, first-generation techniques were rejected in favour of PLS-SEM, for the following reasons:

- The number of observations was inadequate for both Factor Analysis and CB-SEM, but adequate for PLS-SEM

[3] For a full list and description of the rules of thumb for selecting the most appropriate of these techniques, the reader is referred to Hair, et al.,(2011)

- The model was complex, with many constructs and many indicators

- The use of PLS-SEM is especially suited for exploratory studies where the measures are new and the relationships had not been tested before (Esteves et al., 2003). In the case of this research study, the survey instrument was newly-developed, thus the measures were new. In addition, the core relationship between Occupational Community of Practice Strength of Commitment and knowledge transfer barriers and Work Practice Compatibility have not previously been tested.

- Given that the purpose of this study is to explain the variances in ERP success, and given that the primary objective of PLS-SEM is to maximise the explained variance of the dependent variable, the use of this technique over CB-SEM is to be preferred.

- In contrast to regression and factor analysis approaches, PLS-SEM allows for the simultaneous assessment of the structural and measurement model. This means that the hypothesized relationships between the constructs can be assessed for empirical validity, and at the same time the measures can be assessed as to how well they relate to each construct. Hence, PLS-SEM is a more rigorous approach to data analysis than regression approaches (Henseler et al., 2009)

Thus, PLS-SEM was used to assess the psychometric properties of the revised study instrument, and to test the research model and hypotheses. The results of the analysis of the main study data is discussed in detail in Section 9.4.

6.5.2. Reliability and Validity

In most types of research, including IS and social science research, many of the variables that are of interest and the outcomes that are of importance are abstract concepts or theoretical constructs (Kimberlin & Winterstein, 2008; Straub, Boudreau, & Gefen, 2004). The value of the research and the conclusions that are drawn from the results is dependent on the quality of the instrument that was used to measure the constructs of interest. The two key indicators of the quality of a measurement instrument are reliability and validity of the measures (Bryman & Bell, 2003; Field, 2009).

Reliability refers to the consistency of a measure. A test is considered reliable if the results can be interpreted consistently across different situations (Field, 2009; Sapsford, 2007). Validity is the extent to which a test measures what it claims or intends to measure (Field, 2009; Sapsford, 2007). Straub et al (2004) present a detailed review of the different types of reliability and validity, and their applicable measurement techniques They also provide a set of guidelines for IS research, which identifies the available research validities and indicating their recommendations for their use.

However, given the objective of the pilot study, the main concerns were to

- determine the extent to which the measures that should be related to each other within the same construct were in fact related to each other. This was assessed by measuring internal consistency, using Cronbach's Alpha coefficient. Internal consistency gives an estimate of the equivalence of sets of items from the same test (Kimberlin & Winterstein, 2008). The coefficient of internal consistency is based on the assumption that items measuring the same construct should correlate. Internal consistency has been recommended as a mandatory test (Straub et al., 2004) and has also proved to be very popular in both IS and social science research. The most widely used and recommended method for estimating internal consistency is Cronbach's Alpha (Field, 2009; Straub et al., 2004), which is a function of the average inter-correlations of items and the number of items in the scale.

- determine the extent to which "the measures selected for a given construct are, when considered together and compared to other constructs, a reasonable operationalisation of the construct" (Straub et al., 2004, p. 388). This issue relates to construct validity, which consists of two key concepts: convergent and discriminant validity (Sapsford, 2007). Convergent validity is demonstrated if the items thought to make up a construct correlate highly with one another, particularly when compared to the convergence of items relevant to other constructs

(Straub et al., 2004). The comparison with other constructs distinguishes convergent validity from internal consistency. Discriminant validity is demonstrated when there is no cross-loading on constructs by theoretically unrelated measures. Discriminant and convergent validity were measured using Factor Analysis, a technique popularly used by other related studies (for example Compeau et al., 2007; Karahanna et al., 2006) and recommended by Straub et al (2004).

- Understand the reasons for any weaknesses identified. Face validity was used for this purpose. Face validity is the simplest form of validity that is based on the content and phrasing of the item (Sapsford, 2007), which could lead to a better understanding of any problems identified with the psychometric properties of the scales.

Section 7.5 provides a comprehensive discussion of the pilot study analysis results.

For the main study, reliability was also assessed through internal consistency, measured using Cronbach's Alpha. As discussed above, for the main study, the PLS technique was adopted for data analysis, and therefore validity was assessed in conjunction with the structural relationships between the variables. Section 9.4.1 provides a detailed discussion of the validity results for the main study.

6.6. Ethical Considerations

Ethical approval was obtained for this project (see Appendix 1) during October 2010 after demonstrating adherence to the relevant ethical guidelines as set out by the Open University (available at http://www.open.ac.uk/research-ethics/index.shtml). Some of the more important considerations are briefly discussed below.

6.6.1. Informed Consent

At the individual level, consent was obtained on the first page of the questionnaire. On the first page of the survey, respondents are advised of the purpose of the research study and are asked to confirm their consent by clicking on the appropriate consent box (See Appendix 1). As explained in Appendix 1, the survey responses are completely anonymous and therefore individual responses cannot be identified. As such, all responses are included in the final data set.

For the pilot study, it was necessary to obtain consent at the company level as the study was administered as a case study within a single organisation. Consent at the company level was obtained from the National IT Manager through telephone discussions and confirmed via email.

6.6.2. Confidentiality and Privacy

Respondents are identified by a random number allocated by the internet-based company hosting the survey. Any personal information requested from the respondent, such as name and email address, was optional. Responses were coded by the researcher personally, and all statistical analyses were at a level of aggregation that will prevent any individual identification.

6.6.3. Harm, Risk and Deceit

No deception was required for this study and therefore all participants were able to provide informed consent. All data were anonymised and therefore the participants were not at risk of detrimental consequences by participating.

6.7. Development of the Survey Instrument

Due to the unique integration of concepts selected for investigation, a survey instrument was developed specifically for this research. This section begins with a discussion of the guidelines used for the design of questionnaires, followed by a review of the measurement types and scales that were selected for use in the questionnaire.

6.7.1. Guidelines for Questionnaire Design

The following guidelines proposed for questionnaire design (Blaxter, Hughes, & Tight, 2006; Ghauri & Grønhaug, 2002; Olivier, 2004; Riley, Wood, Clark, Wilkie, & Szivas, 2000; Trochim, 2000) where adhered to during the development of he survey instrument:

- Questions and answers provided should use simple and concise language. Consideration must be taken of the respondent's educational level, knowledge of the subject matter and mother tongue of the respondents (Ghauri & Grønhaug, 2002)
- No unrealistic demands should be made on the respondents in terms of time, know-how, memory or willingness to respond. Insufficient time will cause the respondents to rush, decreasing the accuracy of the information provided. Asking respondents questions that they do not understand or that require a lot of effort to complete will more often than not cause them to give up (Olivier, 2004)
- Each question should be about one thing only. Having double-barrelled or portmanteau questions makes it difficult to select only one answer, thus potentially reducing the accuracy of the responses.
- Questions should not be of a directive nature, directing the respondent to a specific answer or opinion. This will result in the respondent contributing negatively to the conclusions of the study (Ghauri & Grønhaug, 2002)
- The provision of escape routes (for example, 'don't know' or 'not sure' options) for questions should be used with care. Self-administered questionnaires generally have a lower response rate (of about 22%) if no escape routes are provided. However, escape routes are used by respondents wanting to avoid answering questions, which will naturally prevent the researcher from obtaining the required information. Therefore, Ghauri and Grønhaug (2002) suggest that escape routes should not be used. However, it has also been suggested (Hair et al., 2003; Olivier, 2004) that each question should have an escape route, in order to prevent respondents from fabricating answers to questions that they may find sensitive in nature or genuinely do not have an answer

for. Consequently, it was decided to make use of a "Not Applicable" option where appropriate. "Somewhat agree" and "Somewhat disagree" options were used instead of "Don't know" or "Not Sure" options for all appropriate question,

- Questions should be asked in a polite and soft manner. They should not irritate, offend or provoke the respondents (Ghauri and Grønhaug, 2002)
- The order of the questions must be considered. It is important to place sensitive questions in the right place so that the respondent can understand why the question needs to be asked. In addition, questions should be asked in a logical and systematic sequence to avoid misunderstandings (Ghauri and Grønhaug, 2002). Easy to answer and positive questions should be asked first, otherwise the respondents may be given the impression that all the questions are complicated and difficult, resulting in them not responding at all.
- All questions pertaining to a particular section should be coded either positively or negatively, as reverse-coding of items can introduce systematic error (Blau & Holladay, 2006; Irving et al., 1997)
- The layout should be easy to follow. In particular, the more professional the appearance of the questionnaire, the better the responses that are elicited (Olivier, 2004).
- Clear instructions must be provided.
- A pilot study should be conducted to test the questionnaire before the real study begins. (Olivier, 2004). This will allow the researcher to determine whether or not the preceding guidelines have been correctly implemented.

6.7.2. Data Measurements

Multi-item scales were developed for each construct; most of which used six-point Likert-type interval scales ranging from 'strongly disagree' to 'strongly agree'.

Interval variables (Bryman & Bell, 2003) were deemed most appropriate as interval measures are used primarily to measure concepts such as feelings, opinions, perceptions and values (Hair et al., 2003), through the use of rating scales. Rating scales involve the use of statements on a questionnaire in conjunction with pre-coded categories. One of these categories is then selected by the respondent to indicate the extent of their agreement or disagreement with the statement.

As it was necessary to make use of multi-item scales for validation purposes (see section 6.5.2), a summated ratings scale was used. Summated ratings scales are used predominantly to measure attitudes and opinions. They typically use a 5-point or 7-point scale to assess the strength of agreement or disagreement about a group of statements. A label is developed for each point on the scale to describe the intensity of the respondent's feeling. When several statements are used to describe a single concept, the sum of the scales for all of the statements is referred to as a summated ratings scale or multi-item scale (Bryman & Bell, 2003). If the scale is used for individual statements, it is referred to as a Likert scale. Likert scales are also the most frequently used types of scales used to measure attitudes (Bryman & Bell, 2003)

6.8. Operationalisation of Measures

The measures selected to operationalise the constructs were a mixture of pre-existing items validated in relevant prior studies, and newly developed items. Some of the pre-existing items were adapted to cater for the current research context.

6.8.1. Occupational Communities of Practice Strength of Commitment (OCS)

The scale used to operationalise this construct was adapted from Meyer et al's (1993) model which conceptualised occupational commitment as a three-dimensional construct consisting of affective, normative and continuance dimensions (see section 4.4.2.1 for a description of these dimensions). Following Lee et al's (2000) conceptualisation of this construct, however, occupational strength of commitment is operationalised in terms of the affective dimension only for this research study. The reasons for this are two-fold:

(1) Problems with the discriminant validity between the affective, normative and continuance dimensions were identified. However, it was established that whilst the other two dimensions seem to depend interactively on each other, affective commitment is a 'stand alone' dimension that demonstrates acceptable discriminant validity (Blau, 2006)

(2) Of the three dimensions, affective commitment is seen to lead to the strongest level of attachment or bond than the other dimensions. According to Meyer and Herscovitch (2001), an attachment that is borne out of desire rather than need or obligation will lead more strongly to the behaviours and reactions that are of interest for this research study. For example, high levels of affective commitment would lead to a higher level of resistance by members to outside practices and knowledge than normative or continuance commitment. Thus, measuring occupational strength of commitment in terms of affective commitment is deemed an effective and appropriate measure for the purposes of this study.

The items comprising the scale are reflected in Table 10. Following Blau (2006), three of the items (OCS2, OCS4 and OCS5) were changed from reverse-coded to positive-coded. This was done to eliminate the potential for introducing systematic error to the scale, as noted by some researchers (for example Irving et al., 1997).

Table 10: Occupational Strength of Commitment Item Scale

OCCUPATIONAL STRENGTH OF COMMITMENT	
OCS1	My occupation / line of work is important to my self-image.
OCS2	I do not regret having entered my chosen occupation / line of work.
OCS3	I am proud to be in my chosen occupation / line of work.
OCS4	I enjoy being a member of my chosen occupation / line of work.
OCS5	I identify with my chosen occupation / line of work.
OCS6	I am enthusiastic about my chosen occupation / line of work.

6.8.2. Barriers to Knowledge Transfer

As discussed in Section 4.3, Szulanski's (2003) framework for knowledge transfer forms the theoretical basis for this group of constructs within the research model. However, many of the item scales in his original survey instrument were considered to be incompatible with the context of this study for two reasons:

(1) Szulanski's study focuses on the transfer of knowledge between organisational units rather than on the transfer of external knowledge during the introduction of a new technology into the organisation.

(2) The potential effects of work practice compatibility and occupational communities of practice strength of commitment were not included in Szulanski's study.

Consequently, when operationalising the barriers to knowledge transfer constructs as identified by Szulanski, it was deemed necessary to tune the questions to the context of the overall research question. As a result, in developing the item scales for each of the barriers of knowledge transfer, the literature was investigated to identify existing survey instruments that preserved Szulanski's original definitions of the constructs, but at the same time had adapted his original questionnaire for use within an ERP, as well as within an occupational communities of practice, work practice compatibility or equivalent, context. New items were developed where necessary.

Furthermore, the literature review identified an additional barrier that had not been included in Szulanski's original framework, namely Shared Understanding, as discussed in Section 4.3.2.4).

The actual item scales used for each of these constructs are listed in Table 11. Thereafter, the development of the item scales is discussed in more detail.

Table 11: Barriers to Knowledge Transfer Item Scales

BARRIERS TO THE KNOWLEDGE TRANSFER PROCESS	
ABSORPTIVE CAPACITY	
ABSORPTIVE CAPACITY – SYSTEM KNOWLEDGE	
Before the system was implemented:	
ACS1	I understood the basic concept and functions of systems like this
ACS2	I understood the system well enough to be able to do my job effectively
ACS3	I was able to recognize inadequacies in the system
ABSORPTIVE CAPACITY – WORK DOMAIN KNOWLEDGE	
ACW1	Which of the following best describes you? (Please select ONE only) ▪ My occupation / job requires a formal degree / training course / apprenticeship which I have obtained. ▪ Although my occupation / job does not require any formal qualifications, I have completed one or more relevant courses ▪ I am in the process of completing a formal degree / training course / apprenticeship with the expectation of obtaining a higher position within my current line of work ▪ I am in the process of completing a formal degree / training course / apprenticeship with the expectation of moving to a different line of work ▪ I have completed a formal degree / training course / apprenticeship for a job that is different to the one that I am currently employed to do ▪ None of the above ▪ Other (please specify)
ACW2	You keep up to date of the latest developments in your occupation / job through... (Please select ALL that apply) ▪ Subscription to journals / trade magazines ▪ Membership of online discussion forums / groups ▪ Attendance at conferences ▪ Informal discussions and / or get-togethers with colleagues from other companies ▪ None of the above ▪ Other (please specify)
ACW3	Do you belong to an association relevant to your occupation / job title, eg CIS, PAAB, Salesmen Association, Truck Driver's Association
UNPROVEN KNOWLEDGE	
Before the system was implemented:	
UK1	I thought that the system would be able to support every task that I needed to perform
UK2	I knew of other people, with similar job titles as me, working in other companies, who had successfully used systems like this in the past
UK3	I was expecting the system to increase my job effectiveness

BARRIERS TO THE KNOWLEDGE TRANSFER PROCESS	
SOURCE CREDIBILITY	
SC1	I felt that the system implementation team was trustworthy
SC2	The system implementation team appeared well trained in the new system
SC3	The system implementation team was willing to accommodate my needs into the new system
SC4	The system implementation team was able to understand how I work
ARDUOUS RELATIONSHIP	
AR1	The system implementation team and I helped each other to implement the system
AR2	The system implementation team and I agreed on what would be acceptable outcomes for the implementation of the system
MOTIVATION	
MO1	I was reluctant to accept the new ways of working that came with the system
MO2	Overall, I looked forward to implementing and using the system
MO3	To what extent did you react with each of the following to the introduction of the system? Please give a rating for EACH of the reactions below ▪ Enthusiasm ▪ Cooperation ▪ Tolerance ▪ Passivity ▪ Reluctance ▪ Feigned acceptance ▪ Hidden sabotage
MO4	Which of the following applied to you during the implementation of the system? ▪ I complained a lot ▪ I tried to convince management not to implement the system ▪ I took a long time to provide any information that I was asked for ▪ I did not want to change anything that I was currently doing because of the new system ▪ I looked for ways around the system so that I did not have to change anything that I was doing before the system was implemented. ▪ I avoided learning and using the new system as much as possible ▪ I thought about finding another job
SHARED UNDERSTANDING	
SU1	The system Implementation team and I agreed on what's important.
SU2	The system Implementation team and I understood each other when we talked.
SU3	The system Implementation team appeared to have a good understanding of the regulations, rules and policies that I have to comply with in doing my job.

6.8.2.1. Absorptive Capacity

Absorptive capacity (AC) is defined as the ability of the recipient to identify value in and apply new knowledge, and is a function of the level of prior related knowledge (Cohen & Levinthal, 1990; Szulanski, 2003). As discussed in section 4.3.2.1, within the context of this research study the AC construct is operationalised as a two-dimensional construct, consisting of (1) Absorptive Capacity of System Knowledge, and (2) Absorptive Capacity of Work Domain Knowledge.

Absorptive Capacity – System Knowledge

Three items are used to measure this construct. ACS1 and ACS2 were taken from Park et al's study which investigated the relationship between users' perceived absorptive capacity and performance using ERP systems. ACS3 was adapted from Szulanski's (2003) item scale measuring stickiness during the implementation phase.

Absorptive Capacity – Work Domain Knowledge

This scale consists of three items, all of which are new items developed based on Szulanski's absorptive capacity item scale. ACW1 assesses prior knowledge in terms of the level of formal training that the user had obtained relevant to the user's tasks. ACW2 and ACW3 assess the user's knowledge about the most recent developments in their field.

6.8.2.2. Unproven Knowledge

Szulanski defines Unproven knowledge as "the degree of conjecture on the utility of the transferred knowledge" (Szulanski, 2000, p.19). Within the context of this study, unproven knowledge is more narrowly conceptualised as the extent to which users expect the ERP system to be useful to them.

Three items are used to measure this scale. UK1 was adapted from Kositanurit et al.'s (2006) study which tested the relationship between task-technology fit, user satisfaction and individual performance. UK2 was adapted from Szulanski's item scale. UK3 was adapted from Staples & Seddon's (2004) study which tested the validity of Goodhue & Thomson's (1995)Technology to Performance Chain model within mandatory and voluntary use contexts.

All three questions are reverse coded: responses with high values indicate high perceptions of usefulness, whilst low values indicate low perceptions of usefulness, that is, that the users perceived that the ERP system was "unproven" in terms of its ability to be useful to them.

6.8.2.3. Source Credibility

Source credibility refers to the perception of the users of the credibility of the source of the knowledge (Szulanski, 2003). Within an ERP context, the source of the knowledge refers to the implementation team.

This construct was operationalised using a four-item scale. SC1 and SC2 were taken from Ko et al's (2005) study which investigated the effects of selected barriers to knowledge transfer on the overall effectiveness of the knowledge transfer process within an ERP context. SC3 was taken from Szulanski's original scale as it aligned well with the compatibility context of this study, SC4 is a new item developed to tune with the occupational communities of practices aspect of this study.

6.8.2.4. Arduous Relationship

This construct refers to the nature of the relationship between the source (implementation team) and the recipient (user).

Only two items are used to measure this construct. Both items were derived from Szulanski's original item scale in combination with Xu & Ma's (2008) study which investigated the factors that affected the effectiveness of ERP knowledge transfer from consultants to key users.

Both questions are reverse coded: responses with high values indicate an easy relationship between the parties, whilst responses with low values indicate a difficult (arduous) relationship between the parties.

6.8.2.5. Motivation

Motivation is defined by Szulanski (2003) as the willingness of the recipient to accept, recreate and apply knowledge from an external source. This construct can also be viewed as User Resistance with Klaus et al (2007) offering the most appropriate definition within the ERP implementation context (see section 4.3.2.1).

For parsimonious reasons, it was deemed necessary to select as few items as possible to measure this construct, whilst at the same time attempting to encompass the most important and relevant aspects of this construct within the context of this study.

Four items were selected to measure this construct. MO1 aligns with the working practice compatibility context of this study, and was derived from Timbrell's (2001) study which investigated Szulanski's knowledge transfer framework within an enterprise system context. MO2 relates to the overall willingness of the user and was taken from Xu & Ma's (2008) study (discussed above). MO3 assesses user responses to the introduction of the system, and was adapted from Szulanski's original instrument. MO4 assesses the extent of resistance behaviour and was adapted from Klaus et al's (2007) study which investigated user resistance in enterprise system implementations. This item was made optional due to its potential sensitivity to respondents.

6.8.2.6. Shared Understanding

Shared understanding is defined as the similarity in the source (implementation team) and recipient's (user) work values, norms, philosophy, problem solving approaches, and prior work experiences (Ko et al., 2005).

Three items are used to measure this construct. SU1 and SU2 were taken from Ko et al's (2005) study which is described above. SU3 is a new item developed to align with the occupational communities of practice context of this study.

6.8.3. Process and System Adaptation

Process adaptation refers to the extent to which users' work practices were adapted to suit the functionality and Best Practices embedded within the ERP system. System adaptation refers to the extent to which the system was adapted to suit the users' work practices.

Item scales used for both the Process Adaptation and System Adaptation constructs were adapted from Hong & Kim's (2002) research instrument. In their study, Hong & Kim investigate compatibility at the organisational level, in terms of "organisational fit", defining it as the "degree of alignment between the ERP model and organisational needs in terms of data, process and user interface" (Hong & Kim, 2002, p.30). Thus, their questions relating to process and system adaptation assessed the extent to which adaptation occurred in terms of data, process and user interface aspects.

In contrast, this research study investigates compatibility at an end-user level, investigating the relationship between the fit of the system to individual work practice needs and ERP implementation success.

Consequently, tor the System Adaptation scale, Hong & Kim's questions were modified to assess the extent to which the system was adapted to be more compatible with the users' work practices, in terms of the three dimensions of work practice compatibility defined for this study. Similarly, for the Process Adaptation scale, Hong & Kim's questions were modified to assess the extent to which the users' tasks were adapted to be more compatible with the system. The items comprising the process and system adaptation scales are listed in Table 12.

Table 12: Process and System Adaptation Item Scales

PROCESS ADAPTATION	
While the new system was being implemented, attempts were made to change:	
PA1	The tasks that I was currently doing, to fit in with the new system
PA2	The way that I was currently doing my tasks, to fit in with the new system
PA3	The way that I was taught to do my job during my formal training (trade school, college, university), to fit in with the new system
PA4	The way that I prefer to work, to fit in with the new system
PA5	The rules, regulations and policies that I have to comply with in my job, to fit in with the new system
SYSTEM ADAPTATION	
While the new system was being implemented, attempts were made to change the system so that it better matched:	
SA1	The tasks that I was doing before the system was implemented
SA2	The way that I was doing my tasks before the system was implemented
SA3	The way that I was taught to do my job during my formal training (trade school, college, university)
SA4	The way that I prefer to work
SA5	The rules, regulations and policies that I have to comply with in my job

6.8.4. Work Practice Compatibility

In keeping with the definition developed from the literature for the purposes of this research study (see section 3.4.3), this construct is operationalised in terms of the three sub-scales of (1) Compatibility with Existing Work Practices, (2) Compatibility with Preferred Work Practices, and (3) Compatibility with Imposed Work Practices.

The construct and its subscales were operationalised drawing predominantly on the works of Karahanna et al (2006) and Goodhue & Thompson (1995). Karahanna et al's study reconceptualised compatibility as a four-dimensional construct and investigated the effects of these four dimensions on information system usage. Similarly, Goodhue & Thompson's study investigated the effects of Task-Technology Fit on individual performance. In developing their respective research instruments, both studies drew on the work of Moore &

Benbasat (1991) who developed an instrument for measuring individual perceptions of adopting IT innovations.

Table 13: Work Practice Compatibility Item Scales

COMPATIBILITY WITH EXISTING WORK PRACTICES	
WPE2	To use the system, I did not have to make significant changes to the tasks that I was doing before the system was implemented
WPE3	To use the system, I did not have to make significant changes to the way I was doing my tasks before the system was implemented
WPE4	The system provides me with the same information that I had before the system was implemented
COMPATIBILITY WITH PREFERRED WORK PRACTICES	
WPP3	The system allows me to work in the way that I want
WPP2	The system provides me with the exact information that I would like to have to do my job
COMPATIBILITY WITH WORK PRACTICE REGULATIONS OR LAWS	
WPI	The system allows me to comply with the regulations, rules and policies that are required in doing my job
WPI2	The system allows me to comply with the work practices that I was taught during my formal training for my job (at trade school, college, university)
WPI5	The system provides me with the exact information that I am expected to provide to other members of my company
WPI6	The system fits with the unique requirements of the organisation
OVERALL WORK PRACTICE COMPATIBILITY	
WPO2	The system has resulted in flawed or defective work processes
WPO3	The system is compatible with all aspects of my work
WPO4	The system is missing critical information that is very useful to me in my job

Wherever possible, items from Karahanna et al and Goodhue & Thompson were used. To accommodate for the ERP and occupational communities of practice contexts of this study, item scales from other studies were used and/or adapted, and where necessary, new items were developed.

The actual item scales used for each of these constructs are listed in Table 13. the development of the item scales is discussed in more detail next.

6.8.4.1. Compatibility with Existing Work Practices (WPE)

WPE2 and WPE3 were adapted from Karahanna et al's (2006) study, whilst WPE4 was adapted from Goodhue & Thompson's (1995) study. (Karahanna et al's third item in this subscale was considered to relate to work practices in general and was therefore used in the development of an item for the overall work practices subscale – see 6.8.4.4)

6.8.4.2. Compatibility with Preferred Work Practices (WPP)

Only two relevant items could be found to measure this subscale without having to include duplicate questions or questions with problematic phrasing. WPP2 was derived by combining items from Goodhue & Thompson (1995) and Kositanurit et al.'s (2006) studies. WPP3 was derived by combining items from Karahanna et al.s (2006) and Staples & Seddon's (2004) studies.

6.8.4.3. Compatibility with Imposed Work Practices (WPI)

This subscale is based on Karahanna et al.'s "compatibility with values" subscale, which is defined as "epitomizing the match between the possibilities offered by the technology and the user's dominant value system." (Karahanna et al., 2006, p.787) In the context of occupational communities of practice, such values can be seen to be shaped by, inter alia, any work practices that are imposed by the referent occupational communities of practice, both internal and external to the organisation. This can include the prior training, rules and regulations that govern the work practices of the referent community of practice, as well as the specific and unique internal rules and regulations of the organisation itself. Therefore, this subscale has been adapted to more narrowly define and assess the extent to which the system caters to the laws and regulations that govern users' work practices, rather than users' overall beliefs and values. WPI5 was adapted from Goodhue & Thompson (1995). The other three items were newly developed for this subscale.

6.8.4.4. Overall Work Practice Compatibility (WPO)

This subscale measures the extent to which the system meets the users' work practice needs overall, and is intended as a validation of the WPP, WPE and WPI subscales. WPO2 was adapted from Lee et al's (2007) qualitative study which investigated the effects of misfits between the Best Practices embedded in ERP systems and user interactions on the adoption and use of ERP systems within a knowledge transfer perspective. WPO4 is adapted from Goodhue & Thomson's (1995) study. WPO3 was derived by combining items from Karahanna et al (2006) and Staples & Seddon's (2004) studies. WPO2 and WPO4 are reverse-coded to their phrasing.

6.8.5. Quality in Use

Table 14: Quality in Use Item Scale

QUALITY IN USE		
QIU1	I am able to do my job better using the system	Effective + Efficient
QIU2	I am able to do more work in the same amount of time using the system	Efficiency
QIU3	Using the system has increased the quality of my work output	Effective + Efficient
QIU4	I am able to complete all my tasks more accurately using the system	Effectiveness
QIU5	I am more satisfied in my job since I have been using the system	Satisfaction
QIU6	If you were told that the company was going back to the old system, which of the following best describes how you would respond? (Select ONE only) ▪ Over my dead body – this system is much better than the old one ▪ Over my dead body – I have invested far too much time and effort to go back to the old system now ▪ I know there are problems but we can fix it ▪ Take it and good riddance ▪ Other (please specify)	Satisfaction

This construct relates to the benefits of system use (as defined in section 3.2.2) in terms of the perceived impacts of the system on user job performance. Given the non-availability of actual measures of completion and accuracy times, attitudinal measures were used in terms of the users' perceptions of how the system has affected their overall job performance. Quality in Use was therefore measured using the 6 items reflected in Table 14. The first 5 questions were based on the studies by Staples & Seddon (2004), Park et al (2007) and Rai et al (2002) and adapted to conform to the definition of Quality in Use in terms of the three measures of effectiveness, efficiency and satisfaction. The sixth item was newly developed based on discussions held with an ERP consultant (Silberstein, 2011).

6.8.6. Demographics

Standard demographic questions such as age, gender, country of work and education level could affect the responses and were therefore included in the questionnaire as reflected in Table 15. . Many of these questions were originally included to allow for the detailed analyses discussed in section 6.2.1, and served the dual purpose of screening respondents for validity as a result of using the internet to collect data for the main study (Schmidt, 1997). For example, job Title (D1) was used initially to identify the occupational community of practice to which the respondent belonged, and was also used to determine whether the respondent is a bona fide user of an ERP system. The department question (D5) was used to validate the job title. Questions relating to industry (D9) and job groupings (D2) were used to cross-validate each other and where necessary re-categorise the user's selected responses.

Table 15: Demographics

DEMOGRAPHICS	
D1	What is your Job Title?
D2	Which one of the following groupings best describes your occupation?
D3	Number of years in your current position
D4	Number of years in this line of work
D5	What department do you primarily work in?
D6	Which of the following best describes your involvement in the implementation of the computer system that you are currently using? • I was a member of the system implementation team • I was not a member of the implementation team but I discussed my needs with one or more members of the team • I had no interaction either directly or indirectly with the implementation team • I joined the company after the system was implemented • I was in a different job before the system was implemented
D7	Did your company employ external consultants to assist in the implementation of the system
D8	Highest Level of Education High School or Lower / Trade School / Bachelors / Masters / MBA / PhD
D9	Please select the name of the system that you are currently using

DEMOGRAPHICS	
D10	How long have you been using the current computer system? 0-6 months / 6–12 months / 12-24 months / 2–5 years / > 5 years
D11	Which of the following industries do you work in?
D12	In what country do you work?
D13	Gender (optional)
D14	Age < 21 / 21 – 27 / 28 – 34 / 35 – 41 / 42 – 48 / 49 - 55 / 56+

Questions D3 and D4 were included to determine the effects that time working in a particular job or line of work would have on user perceptions. Similarly, question D9 was included to determine the effects of different makes of ERP systems on user perceptions. Question D7 was included to control for the effects of using external consultants during the implementation process.

Question D6 is a branching question. Respondents who indicated that they were members of the implementation team, or who discussed their needs, continued on to answer all the questions in the survey. Respondents who indicated that they had no interaction with the implementation team skipped all questions relating to their perceptions of the implementation team. Respondents who joined the company after the system was implemented skipped all questions relating their perceptions of the implementation team, as well as questions relating to perceptions of compatibility with existing work practices. Respondents who indicated that they were in a different job before the system was implemented skipped the questions relating to perceptions of compatibility with existing work practices.

6.9. Summary

This chapter discussed the research design and relevant data collection and analysis methods selected for this study, which is summarised in Table 16.

Ethical considerations relating to this research were discussed. Guidelines for survey instrument development were presented, together with a detailed explanation of how the constructs were operationalised. As the survey instrument was newly developed for the purposes of this research, it was deemed necessary to test the instrument through the use of a pilot study prior to conducting the main study. In the following chapter, the pilot study and the results are discussed.

Table 16: Research Design Summary

ELEMENT	TYPE
Ontology	Relativism
Epistemology	Relativism
Strategy	Quantitative
Research Design	Survey Research
Data Collection	Questionnaire
Data Analysis • Pilot Study • Main Study	• Factor Analysis • PLS-SEM

CHAPTER 7

THE PILOT STUDY

> "I don't see much sense in that," said Rabbit. "No," said Pooh humbly, "there isn't. But there was going to be when I began it. It's just that something happened to it along the way."
>
> *Winnie the Pooh – Pooh's Little Instruction Book*

7.1. Introduction

This chapter describes the administration and results of the pilot study that was conducted to test the reliability and validity of the research instrument. Weaknesses in the survey items were exposed, as well as a debate in the literature surrounding one of the variables within the research model. Overall, the findings of the pilot study resulted in a refinement of both the research model and the survey instrument.

The chapter begins with a review of how the study was conducted (7.2), followed by an explanation of how the survey instrument was adapted to suit the context of the sample (7.3). Sample characteristics are presented in section 7.4.

The reliability and validity of the instrument are discussed in detail in section 7.5. Specifically, the internal consistency of the instrument, as measured using Cronbach's coefficient alpha, is presented in section 7.5.1. This is followed by a detailed discussion of the factor analysis results in section 7.5.2, which were used to determine the discriminant and convergent validity of the measures. Section 7.5.3 presents a review of the survey items as a means of explaining the weaknesses identified in the preceding sections.

A summary of the revisions required to be made to the survey instrument is presented in section 7.6, which completes the chapter.

7.2. Study Administration

The study was completed in June 2010 in collaboration with a South African company that was completing its 5-year ERP implementation project. The company selected for the pilot study (hereafter referred to as SACo) was chosen due to a pre-existing and long-standing business relationship between the researcher and the National IT Manager of the company. In addition, 12 of the company's employees had participated in the researcher's MRes dissertation and thus stimulating interest in the larger PhD study.

SACo consists of 6 regions, with multiple retail branches in each region. The operational headquarters are based in Region C with the IT headquarters based in the Western Cape. Each region has its own regional manager reporting to the National IT Manager. The ERP system was implemented over a five year period, one region being implemented per year. Table 17 depicts the time frame for each region's implementation.

Table 17: ERP Implementation Date by Region

Region	Implementation Date
Region A	2004
Region B	2008
Region C	2009
Region D	2007
Region E	2010
Region F	2006

An email explaining the objective of the research study, together with the guarantees of data confidentiality and anonymity was sent to the National IT Manager. The National IT Manager added a paragraph supporting the study and the need to obtain feedback from the end-users as a way of evaluating the implementation to date, and forwarded the email to his regional IT Managers. The regional managers then forwarded the appended email to all their users, requesting their participation in the study.

Initially, the response count was very low. However, the researcher was aware of the significant rivalry that existed between the regions, and consequently began to send daily progress reports to the National IT Manager for circulation to the end users, reporting on the number of responses obtained per region. Within a week of doing this, sufficient responses were obtained to perform the necessary data analysis.

7.3. Instrument Adaptation

It was necessary to adapt the demographic section of the survey instrument slightly to cater for the specific context of the pilot study company. Some questions were removed and one question was added, as reflected in Table 18.

Table 18: Adaptation of Survey Instrument for Pilot Study

Questions Removed	Questions Inserted
What country do you work in?	What Region do you work in?
Which of the following industries do you work in?	
Please select the name of the system that you are currently using	
Did your company employ external consultants to assist in the implementation of the system?	

7.4. Sample Characteristics

In total, 315 responses were obtained, of which 194 were usable, representing 16% of the company's user population. The general demographic characteristics of the sample are reflected in Table 19.

Table 19: Pilot Study Sample Characteristics

Criterion	Level	No	Total
Education			194
	High School or Lower	145	
	Trade School	29	
	Bachelors Degree	11	
	MBA	3	
	Unspecified	6	

Criterion	Level	No	Total
Gender			194
	Male	70	
	Female	114	
	Unspecified	10	
Age Group			194
	<=21	1	
	21 – 27	32	
	28 – 34	41	
	35 – 41	40	
	42 – 48	24	
	49 – 55	27	
	≥ 56	23	
	Unspecified	7	
Department			194
	Accounting & Finance	30	
	Administration	21	
	Info Sys & Tech	16	
	Customer Service	8	
	Inv, W/h & Dist	14	
	Management	6	
	HR	2	
	Purchasing	13	
	Sales & Marketing	63	
	Other	21	
Region			194
	A	21	
	B	3	
	C	102	
	D	25	
	E	5	
	F	38	
Length of time using the system			194
	0 – 6 Months	10	
	6 – 12 Months	90	
	12 -24 Months	13	
	2 – 5 Years	47	
	> 5 Years	28	
	Unspecified	6	

Criterion	Level	No	Total
Number of years in current line of work			194
	< 1 Year	5	
	1 - 2 Years	13	
	2 - 3 Years	9	
	3 - 4 Years	20	
	4 - 5 Years	18	
	5 - 10 Years	35	
	11 - 15 Years	35	
	15 - 20 Years	21	
	> 20 Years	38	

As can be seen from the above, the majority of the respondents were from the region that most recently implemented the system, thus allowing for the pilot study to be tested on a relevant sample population.

7.5. Data Analysis

The pilot study data were used primarily to assess the reliability and validity of the survey instrument prior to administration of the main study. As discussed in section 6.5.2, the main concerns for the analysis of the pilot study data were to assess the reliability, convergent and discriminant validity of the instrument and measures. This was achieved through the following techniques:

- The reliability of the instrument and measures was demonstrated by assessing internal consistency, as measured by Cronbach's coefficient alpha. Reliability is discussed in Section 7.5.1.

- Construct validity in terms of convergent and discriminant validity was demonstrated through the implementation of Factor Analytic techniques, and is reported in detail in Section 7.5.2.

- Understanding the reasons for any of the weaknesses identified in the instrument and scales. Face validity was used for this purpose, and assessed by reviewing the phrasing and sources of each questionnaire item, and examining the actual data collected from the recipients in detail. The results of this assessment are discussed in section 7.5.3

7.5.1. Reliability

As discussed in section 6.8, the research instrument included items to measure 15 constructs. Cronbach's coefficient alpha was carried out only on 13 of these items. The Motivation and Absorptive Capacity of Work Domain constructs were excluded because of problems experienced with coding the items (discussed in sections 7.5.3.6 and 7.5.3.2 respectively). Table 20 reflects the Cronbach's Alpha scores for each of the remaining 13 subscales, together with any items that if deleted, would increase that item's alpha score

Table 20: Cronbach's Alpha Results

	Construct	N	N items	Cronbach α	Delete Item	New Cronbach α
1	OCS	311	6	0.845	OCS1	0.900
2	ACS	218	3	0.773		
3	UK	218	3	0.430	UK2	0.540
4	SC	204	4	0.845		
5	SU	204	3	0.863	SU1	0.893
6	AR	204	2	0.943		
7	SA	204	5	0.850		
8	PA	204	5	0.909		
9	WPE	199	3	0.794	WPE4	0.928
10	WPP	267	2	0.808		
11	WPI	267	4	0.842	WPI2	0.872
12	WPO	267	3	0.629	WPO3	0.700
13	QIU	194	6	0.783	QIU6	0.929
	WPC^	194	12	0.833	WPO2C	0.837
					WPE4	0.839
	WPC¬	194	9	0.813	WPO2C	0.820

Notes:
WPC^ = includes all variables
WPC¬ = excludes items with known problems of WPE4, WPI2 and WPO3

Eleven of the 13 factors reflect high scores, indicating good internal consistency of the scales. However, 7 of these factors each have at least one item that, if removed from the scale, will increase the alpha score of the factor. The scores are discussed below.

- OCS1 is identified as problematic, as deletion of this item will increase the reliability of the OCS scale. However, the alpha coefficient is relatively consistent to those reported in the original research conducted by Meyer et al (1993: 0.85), and other studies (e.g. Blau, 2003: $\alpha = .94$).

- ACS reflects a high alpha score with no problematic items, indicating good internal consistency of the scale for this construct.

- The UK construct reflects a low alpha of 0.430, and even after removing the problematic item UK2, the alpha remains lower than acceptable at 0.530.

- SC and AR both reflect high alpha scores with no problematic items, indicating good internal consistency of the scale. SU reflects a high alpha score which can be even higher if SU1 is removed from the scale, indicating a scale that has good internal consistency.

- The SA and PA scales both reflect high alpha scores with no problematic items, indicating good internal consistency of the scales.

- The QIU scale, including all QIU items, reflects an alpha score of below 0.8. However, when the QIU6 item is removed from the scale, the alpha score increases substantially to above 0.9. .

- The WPC scale is a complex construct that comprises the four subscales of WPE, WPI, WPP and WPO. The alpha score for the WPC scale overall, including all the subscale items, is 0.833; removing items WPO2C and WPE4 increases the alpha scores marginally to 0.837 and 0.839 respectively, indicating that overall, WPO2C and WPE4 are problematic items. However, individual subscale alpha scores reflect more problematic items with this construct:

    - The WPE subscale reflects a substantially higher score if WPE4 is removed.

    - The WPI1subscale reflects a marginally higher score if WPI2 is removed.

- The WPO subscale reflects a score of 0.629 if all three items are included, which increases to 0.7 if WPO3 is removed from the scale.
- The only one of the 4 subscales that does not appear to be problematic is the WPP subscale, however, it only comprises of 2 items.

7.5.2. Construct Validity

Having established the extent of the reliability of the survey instrument, it was then necessary to determine the construct validity of the scales in terms of their discriminant and convergent validity (Straub et al., 2004). Exploratory Factor Analysis was used for this purpose (Kim & Mueller, 1978; Straub et al., 2004). Two steps were required, namely (1) determination of the number of factors to extract, and (2) examination of the factor loadings to assess validity of each of the scales.

Determination of the number of factors

In order to determine the number of factors to extract, the results of a principal components analysis, scree test and parallel analysis were compared. The principal components analysis (Table 21) identified 12 components with an eigenvalue greater than 1, explaining 73.3% of the variance; however, this did not coincide with the 13 factors being measured by the items included in the analysis. Visual inspection of the scree plot, as reflected in Figure 16, was inconclusive.

Parallel analysis, however, indicated that only 8 factors should be extracted, as reflected in Table 22. As the eigenvalue-one rule tends to overestimate the number of factors, particularly when the number of variables is high and the number of respondents is low, as in this case (O'Connor, 2000), it was decided to adhere to the results of the parallel analysis results.

Table 21: Principal Components Analysis

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12.093	24.680	24.680	6.876	14.033	14.033
2	4.328	8.833	33.513	4.259	8.691	22.724
3	4.054	8.273	41.786	3.955	8.071	30.795
4	3.022	6.168	47.954	3.793	7.740	38.535
5	2.287	4.668	52.622	3.503	7.149	45.684
6	2.133	4.353	56.974	2.361	4.819	50.503
7	1.657	3.383	60.357	2.296	4.686	55.189
8	1.557	3.178	63.535	2.272	4.637	59.827
9	1.358	2.771	66.306	2.089	4.264	64.091
10	1.267	2.587	68.893	1.833	3.741	67.832
11	1.138	2.323	71.215	1.521	3.103	70.935
12	1.014	2.070	73.286	1.152	2.350	73.286
13	.906	1.849	75.134			
...	...	...	...			
49	.054	.110	100.000			

Extraction Method: Principal Component Analysis.

Figure 16: Scree Plot

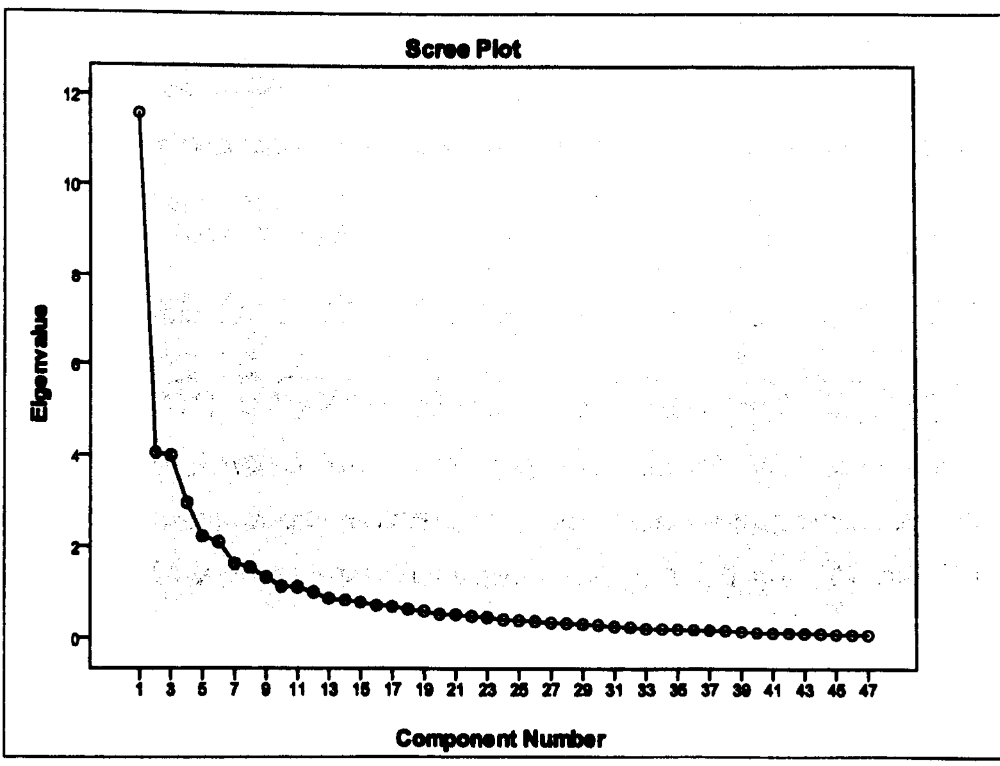


Table 22: Parallel Analysis

Run MATRIX procedure:
PARALLEL ANALYSIS: Principal Components

Specifications for this Run:
Ncases 194 Nvars 49 Ndatsets 1000 Percent 95

Random Data Eigenvalues

Root	Means	PCA	PCA > PARALLEL MEANS?
1.000000	2.134685	12.093	Yes – factor ok
2.000000	2.008663	4.328	Yes – factor ok
3.000000	1.918018	4.054	Yes – factor ok
4.000000	1.840009	3.022	Yes – factor ok
5.000000	1.772285	2.287	Yes – factor ok
6.000000	1.709062	2.133	Yes – factor ok
7.000000	1.649572	1.657	Yes – factor ok
8.000000	1.594200	1.557	Yes – factor ok
9.000000	1.541719	1.358	No – factor not ok

Discriminant and convergent validity

Convergent and discriminant validity was assessed by examining the loadings of the items that were expected to define the subscales in the questionnaire. For this reason, the cut-off point for the factor loadings was set at 0.5 to include only those variables that unambiguously defined each component (Richardson, 1990).

Principal Axis Factoring was therefore used to extract the 8 factors with oblimin rotation. The pattern matrix and factor correlation matrix are reflected in Table 23 and Table 24 respectively. Items that appear to define a particular factor are shaded in each factor column. All loadings of 0.5 and higher are highlighted in bold.

Table 23: Principal Axis Factoring - Pattern Matrix

	Factor							
	1	2	3	4	5	6	7	8
QIU5	.822	-.022	.084	-.104	.097	-.037	-.001	.018
QIU1	.793	.025	.127	-.056	.053	-.068	.011	-.062
QIU4	.752	.085	.042	-.149	.003	.048	-.016	-.072
QIU3	.723	.059	.046	-.167	.030	.003	-.052	.037
QIU2	.671	.122	.058	-.128	.080	-.033	.041	-.080
WPO3	.607	.086	.031	-.111	.021	.079	-.203	-.069
WPP3	.605	.079	.094	-.019	.118	.006	-.201	.008
WPP2	.572	.134	.048	.060	.096	-.062	-.225	.039
WPI6	.467	.003	.085	-.062	.157	.050	-.426	.038
QIU6	-.365	.035	.251	-.117	-.019	.107	-.042	.080
SU5	.135	.738	.087	-.045	-.018	-.030	-.090	-.004
SU3	.006	.724	.105	-.039	-.045	-.041	-.107	-.118
AR2	-.066	.680	.064	-.127	-.064	-.185	-.142	.082
AR1	-.045	.674	.095	-.076	-.005	-.160	-.134	.095
SC3	.154	.622	.072	-.028	.143	-.039	.157	-.033
SC4	.106	.618	.007	.006	.150	-.115	.153	-.006
SC1	.182	.590	.040	.094	.111	.022	.169	-.208
SC2	.218	.583	-.046	.115	-.015	.008	.347	-.165
SU1	-.005	.541	-.033	-.064	-.025	-.234	-.222	-.047
OCS3	.131	.073	.873	.051	.013	.025	.073	.000
OCS4	.116	.008	.863	.015	.006	.013	-.023	.006
OCS6	.040	.054	.809	.020	-.076	-.010	-.054	-.128
OCS5	-.041	.105	.750	-.052	.047	.041	-.013	-.169
OCS2	-.100	.054	.732	.050	.031	-.088	-.025	-.048
OCS1	.177	-.301	.310	.024	-.039	-.107	.085	-.056
PA8	.057	-.092	.028	-.834	-.046	-.198	.040	-.060
PA9	.155	-.105	-.010	-.786	.006	-.097	.055	.007
PA7	-.043	.030	-.073	-.771	.023	-.028	.029	-.127
PA5	.113	.181	-.033	-.745	-.137	-.018	-.065	-.057
PA6	.166	.137	-.004	-.715	-.100	-.056	-.067	-.054
WPE2	.000	.063	.024	.080	.916	-.030	.009	-.030
WPE3	.038	-.013	.062	.100	.889	-.041	.027	.036
WPE4	.093	-.051	-.286	.035	.421	-.170	-.061	-.061
SA6	-.090	.081	-.043	.032	.128	-.868	.004	-.064
SA5	-.087	.062	-.089	-.005	.073	-.858	.011	-.127
SA9	.081	.007	.026	-.145	-.046	-.602	-.019	.023
SA8	.124	.080	.165	-.189	.061	-.559	.143	.191
SA7	-.070	.217	.118	-.176	.059	-.478	-.014	.092
WP1	.222	.101	.129	-.087	.233	.151	-.598	-.047

WPI5	**.471**	.138	.105	-.041	.126	.118	**-.484**	.016
WP12	.131	.023	-.004	-.192	.111	.106	**-.454**	-.135
WPO2	-.148	.017	.041	-.236	.113	.100	**.423**	.036
WPO4	-.237	-.066	.101	-.191	.095	.185	**.369**	-.022
ACS1	-.116	.007	.218	.023	.088	-.068	-.263	**-.696**
ACS3	-.082	-.124	.154	-.132	.012	.019	-.100	**-.589**
ACS2	.109	-.169	.101	-.060	.139	-.060	-.177	**-.511**
UK1	.013	.066	-.056	-.070	-.007	.014	.049	**-.427**
UK4	.099	.090	.041	.111	-.065	-.040	.072	-.280
UK3	-.003	.067	-.004	-.093	.043	.054	.081	-.245

Extraction Method: Principal Axis Factoring.

Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 16 iterations.

Convergent and discriminant validity are established by examining the factor loadings. Convergent validity was deemed to be at an acceptable level when items loaded highly on their own constructs. In contrast, discriminant validity was deemed acceptable when items loaded more highly on their own constructs than on other constructs in the model (Karahanna et al., 2006).

As reflected in Table 23, convergent and discriminant validity could not be demonstrated for all of the scales. Broadly speaking, there is a clear match between six extracted factors and original constructs, namely

- Factor 3: loadings of ≥ 0.5 of the OCS2 – OCS6 items only, suggesting that this factor is defined by the OCS items, and is therefore named the OCS factor
- Factor 4: loadings of ≥ 0.5 of all of the PA items only, therefore named the PA factor
- Factor 6: loadings of ≥ 0.5 of all the SA items only, therefore named the SA factor.
- Factor 5: three items load on this factor, all are WPE items, 2 of which are > 0.5, the third is > 0.4; therefore named the WPE factor
- Factor 7: only 1 item has a loading of ≥ 0.5, which is the WPI1 item. There are 5 items with loadings of > 0.4, two of which are the remaining

items making up the original WPI1scale, and one of the WPO items. Therefore this factor could be deemed the WPI factor.

- Factor 8: all 3 of the ACS items load on this factor higher than 0.5, thus named the ACS factor.

The other 2 factors are problematic in that they appear to consist of more than one of the original constructs:

- Factor 2: this factor appears to be a consolidation of the three constructs SU, AR and SC. This indicates that there is no discriminant validity between the items measuring these constructs and therefore the measures should be revised. Alternatively, this could suggest that the scales SU, SC and AR are equally valid measures of a single underlying construct and that they cannot be differentiated from each other in terms of the construct that they are measuring. In this case, revision of the scales would be pointless. This is inconsistent with the alpha analyses of these three scales, all of which indicate good internal consistency. This issue is discussed further in 7.5.3.7.

- Factor 1: the items that load higher than 0.5 are a mixture of 3 of the original constructs, namely QIU, WPO and WPP. Five of the 6 items measuring QIU, both of the WPP items, and 1 of the three WPO items, load higher than 0.5 on this factor. WPO and WPP together form part of a complex single construct; however, QIU should be an independent construct on its own. The alpha coefficient result for the QIU scale is consistent with the factor analysis results in that the former highlights that item QIU6 is problematic. However, the alpha score does not help to clarify the reason for the high loadings of items from the WPE, WPO and WPP scales onto the QIU scale. Consequently, these results indicate that the items used to measure these constructs should be revised.

Although there is a clear match between six of the extracted factors and 6 of the original constructs, there are some problems with the subscales used for these constructs:

- OCS subscale: OCS1 loaded low relative to the other items in the scale. In addition, it also has a loading of > 0.4 on a second factor, indicating a potential overlap with that factor. These findings are consistent with the Cronbach Alpha results, which indicated that the removal of OCS1 would increase the reliability of the scale.

- SA subscale: SA7 loaded slightly below the 0.5 cut off at 0.497, also somewhat lower relative to the other items in the scale. This is somewhat inconsistent to the SA alpha score, which does not reflect a problem with this item. This is an unexpected result. The PA and SA items are exact mirror images of each other; yet the PA factor analysis is consistent with its alpha score, reflecting good validity and reliability.

- WPE subscale: WPE4 loaded substantially lower than the other two items in the scale, and below the 0.5 cut off at 0.423. This is consistent with the Cronbach Alpha analysis of the scale, which reflects a substantially higher score if WPE4 is deleted.

- WPI subscale: Three of the four items loaded below the cut off point of 0.5, indicating low convergent validity. In addition, WPI6 loaded equally on both its own factor and Factor 1, suggesting a potential overlap. This is not consistent with the Cronbach Alpha analysis, which reflects a marginally higher score if WPI2 is deleted.

- It is also worth noting that the UK construct does not appear as a factor in its own right. The items UK2 and UK3 do not have significant loadings on any of the factors, and UK1 has a low loading on Factor 8, indicating an association with Absorptive Capacity of System Domain Knowledge. Once again, this is consistent with the Cronbach Alpha analysis of the UK scale, which reflects poor internal consistency.

These issues are revisited in section 7.5.3.

Correlations between the Constructs

A secondary aim of the factor analysis was to identify correlations between the constructs. The factor correlation matrix (Table 24) indicates a number of low correlations (.20 – .30) between Factor 1 and the other factors (indicated in bold). However, as Factor 1 is a complex factor these correlations are not easily interpretable in terms of the research model.

Table 24: Principal Axis Factoring: Factor Correlation Matrix

Factor	QIU/ WPP/WPO 1	SU/SC /AR 2	OCS 3	PA 4	WPE 5	SA 6	WPI 7	ACS 8
1								
2	**.257**							
3	.156	.085						
4	-.099	-.180	-.196					
5	**.259**	.136	.003	-.063				
6	**-.227**	**-.274**	-.050	.136	-.127			
7	**.288**	.049	.064	-.028	.090	-.055		
8	**.266**	.165	**.238**	-.138	.182	-.015	.019	

Nevertheless, of interest are the following correlations (indicated in bold):

- Factor 3 and Factor 8, i.e. a (low) correlation exists between the OCS and ACS constructs. This is supported by the argument proposed in the literature review and provides support for the hypotheses proposed in the research model that high levels of occupational strength of commitment could increase users' prior stocks of system knowledge.

- Factor 2 and Factor 6, i.e. that a (low) negative correlation exists between the three barriers to knowledge transfer and system adaptation. This also provides some support for the proposed hypotheses that system adaptation to suit user requirements reduces barriers to knowledge transfer.

7.5.3. Specific Item Issues

The statistical analysis results indicated that the reliability and validity of many of the subscales in the research instrument was not adequate. This led to a review of the instrument items in order to examine the face validity and sources of each item, and resulted in the following additional issues being identified:

7.5.3.1. Absorptive Capacity – System Knowledge

The opening paragraph to this set of questions was phrased: "Before the system was implemented", and could have been interpreted as referring to the amount of training received during the implementation period. Although the statistical analyses found this scale to be both internally consistent and exhibit convergent validity, the opening paragraph is ambiguous and needs to be rephrased to clearly express the intention of measuring prior stocks of system oriented knowledge, as discussed by Szulanski (2003) and Park et al (2007).

7.5.3.2. Absorptive Capacity – Work Domain

Discriminant, convergent and internal consistency of this subscale could not be determined for this scale due to the problem of weighting that arose with ACW1. Would option 1 indicate a higher level of absorptive capacity than level 2? Should option 3 be weighted more highly than option 4? Consequently, this scale was not included in the analysis of the pilot study results.

7.5.3.3. System adaptation and Process adaptation

The original questions were phrased as "significant time and effort have been required to alter ERP…" for system adaptation questions; and "significant time and effort have been required to alter our [processes]" for process (user) adaptation. The wording was changed to "Attempts were made to change", for both sets of questions.

In hindsight, this phrasing is ambiguous. "Attempts were made to change" could have been interpreted as attempts being made by the user, or attempts being made by the implementation team / developers.

The Process Adaptation results could indicate that users felt that they were being forced to change their ways of working to accommodate the system. However, the results could equally be argued that they reflect that the users themselves adapted their ways of working to accommodate the system. Although one could reason that there should not be the same level of system and process adaptation, the means reported in Hong & Kim's (2002) study indicate that this could occur. The System Adaptation results could be argued in the same ways.

One of the underlying hypotheses of this research is that users who are forced to make changes to their working practices will resist change, and thus the Knowledge Transfer process will be detrimentally affected. From the above it is difficult to ascertain whether the changes are forced onto the user or initiated by the user, or in fact, how the user feels in general about the changes. Correlation analysis could be done between these and Motivation, but the motivation questions are themselves problematic and therefore this would not a good indication either.

Therefore, although the factor analysis results indicate strong convergent and discriminant validity for both scales, these questions need to be rephrased to remove the ambiguity.

7.5.3.4. Quality In Use

The factor analysis resulted in an extracted factor defined by the first 5 QIU items together with items from the WPC subscales, indicating a lack of discriminant validity between the QIU and WPC constructs. In addition, the QIU6 item had a loading of less than 0.5 on this factor, reflecting a low convergent validity for the QIU subscale; this is confirmed by the substantial increase in the Cronbach's Alpha score if the QIU6 item is removed from the scale (as discussed in section 7.5.1).

In hindsight, QIU6 does not only measure satisfaction. The second and third options are not indicative of satisfaction with the system, but of other attitudes. Thus, QIU6 should be removed from the scale.

In addition, the wording of QIU3 seems difficult to understand and is duplicated in QIU2 and QIU4, and could therefore be removed. QIU2 could be simplified by restating it as "I am able to perform tasks faster using the system".

7.5.3.5. Work Practice Compatibility

The Work Practice Compatibility construct consists of 4 subscales, namely

(1) WPE – Compatibility with Existing work practices
(2) WPP – Compatibility with Preferred work practices
(3) WPI – Compatibility with Imposed work practices
(4) WPO – Overall Work Compatibility

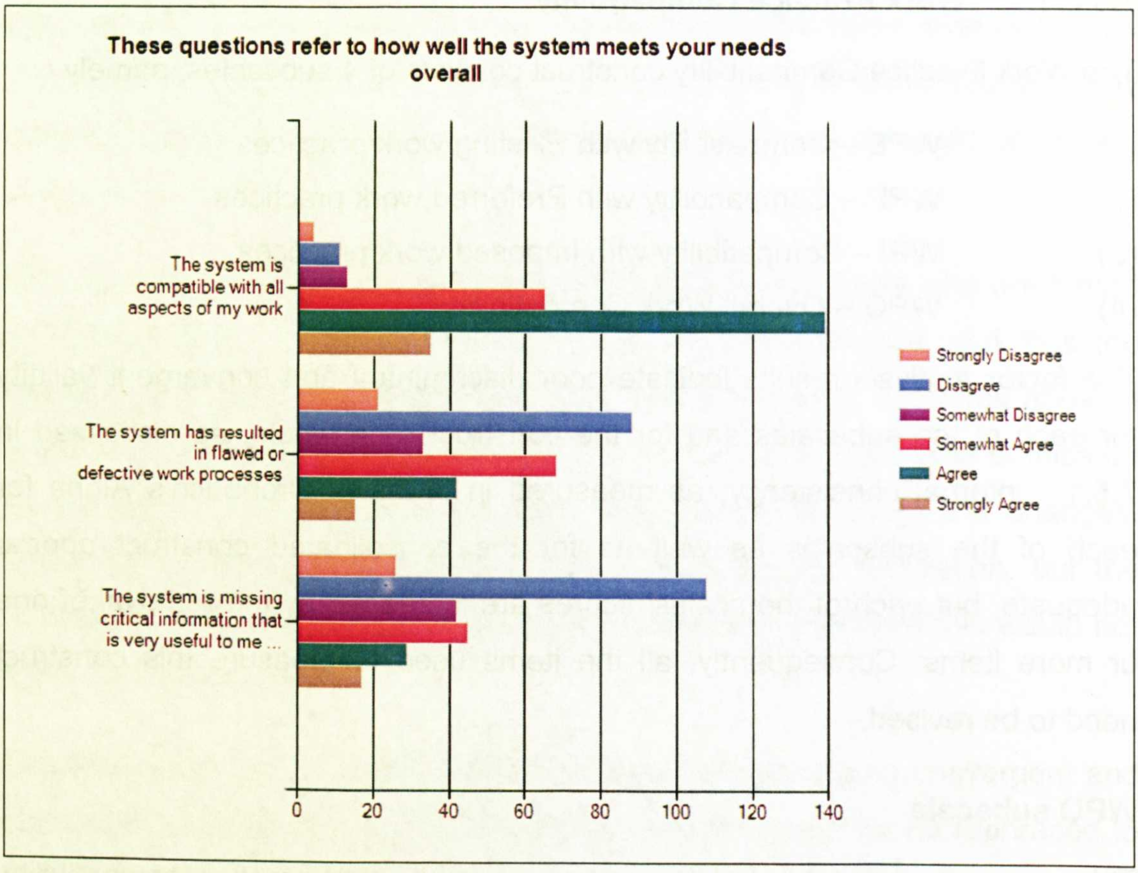
The factor analysis results indicate poor discriminant and convergent validity for each of the subscales and for the construct as a whole, as discussed in 7.5.1. Internal consistency, as measured in terms of Cronbach's Alpha for each of the subscales as well as for the consolidated construct appear adequate, but each of the scales' scores are increased by the removal of one or more items. Consequently, all the items used to measure this construct need to be revised.

WPO subscale

This subscale was intended to measure overall work practice compatibility, thus acting as a validation of the WPP, WPE and WPI subscales. However, the factor analysis reflects poor convergent validity for this subscale as the WPO items did not load on a single factor. In addition, the Cronbach's Alpha score of below 0.7 (for all 3 items) reflects a low internal consistency for this subscale.

Reviewing the actual data from the respondents provides some additional insight into the problems associated with this subscale. As depicted in Figure 17, an overwhelming majority of respondents indicated that the system is compatible with all their needs. However, a considerable number of respondents also indicated that the system resulted in flawed or defective processes. In addition, a large number of respondents have indicated that the system is missing critical information that is useful to them. Therefore, the data is somewhat contradictory: the respondents believe that the system is compatible with their needs, yet at the same time the system has defective work processes and is missing information that is critical to their task performance.

Figure 17: WPO responses



Perceptions of flawed processes and missing critical information could arise as a result of respondents' perceptions of misfits between previous working practices or preferred working practices. Tables 25 - 26 provide a summary of the results for previous and preferred working practices respectively.

Table 25: WPE item responses

20. These questions refer to how closely the system matches the way you PREFER to do your job

Create Chart Download

	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	Response Count
The system allows me to work in the way that I want	2.2% (6)	5.6% (15)	7.9% (21)	24.7% (66)	46.4% (124)	13.1% (35)	267
The system provides me with the exact information that I would like to have to do my job	1.9% (5)	4.5% (12)	5.2% (14)	27.3% (73)	43.4% (116)	17.6% (47)	267
						answered question	267
						skipped question	48

Table 26: WPP item responses

18. These questions refer to how closely the system matches the way you WERE working before the system was implemented

Create Chart Download

	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree	Not Applicable	Response Count
To use the system, I did not have to make significant changes to the tasks that I was doing before the system was implemented	4.0% (8)	11.1% (22)	12.6% (25)	22.6% (45)	39.7% (79)	7.0% (14)	3.0% (6)	199
To use the system, I did not have to make significant changes to the way I was doing my tasks before the system was implemented	4.0% (8)	10.6% (21)	13.6% (27)	21.1% (42)	38.7% (77)	8.0% (16)	4.0% (8)	199
The system provides me with the same information that I had before the system was implemented	10.1% (20)	19.6% (39)	15.1% (30)	14.1% (28)	31.2% (62)	6.0% (12)	4.0% (8)	199
							answered question	199
							skipped question	116

Table 25 reflects that although the majority of respondents indicate compatibility with previous work practices, there is still a considerable percentage of respondents who perceive that the system has caused changes to their previous ways of working. In contrast, Table 26 reflects a much smaller percentage of respondents who feel that the system is not allowing them to perform their tasks the way that they would prefer to. This could suggest that the flawed and missing information perceptions could result from forced changes to previous ways of working.

To enhance the explanatory power of the data, it is suggested that for the main study the survey should include questions relating to the extent and type of workarounds that users have developed. In addition, respondents who indicate perceptions of flawed processes or missing information should be asked to provide an explanation. Alternatively, a list of explanations could be provided based on the above discussions from which respondents could select those that are applicable, with the option to add further explanations if required. For example:

> The system has flawed processes because
> - I cant work the way I used to
> - I cant work the way I want to
> - There are things that I used to be able to do that I cant do anymore
> - There are things that I should be able to do that the system does not cater for
> - It takes longer to do things than it used to
> - The system makes things too complicated

7.5.3.6. Motivation

Discriminant, convergent and internal consistency of this subscale could not be determined for this scale due to the problems that arose with coding item MO3 and the fact that MO4 was an optional question.

MO3, reflected in Figure 18, was adapted from Szulanski (1996), his original survey included this question which requested respondents to select one or more of the options, but no scale was provided. The adapted question did not work well. The responses are summarised in Figure 19.

The majority of respondents have indicated high levels of enthusiasm and cooperation, with very low levels or completely absent behaviours that could be seen as negative. One exception to this is Tolerance – almost 56% of the respondents indicated some to high levels of tolerance. Interestingly, 5 people admitted to some level of hidden sabotage and 17 people admitted to some level of feigned acceptance.

Figure 18: MO3 Item Responses

12. To what extent did you react with each of the following to the introduction of the system? Please give a rating for EACH of the reactions below	None	Very Little	Some	Quite a lot	Very Much	Response Count
a. Enthusiasm	1.4% (3)	2.3% (5)	15.1% (33)	**42.7% (93)**	38.5% (84)	218
b. Cooperation	0.5% (1)	0.9% (2)	7.3% (16)	42.2% (92)	**49.1% (107)**	218
c. Tolerance (wasnt happy but did not interfere)	**29.4% (64)**	17.4% (38)	22.0% (48)	24.8% (54)	6.4% (14)	218
d. Passivity (did not get involved)	**42.7% (93)**	22.0% (48)	20.6% (45)	11.9% (26)	2.8% (6)	218
e. Reluctance (unwilling, didnt really want to get involved)	**64.2% (140)**	22.0% (48)	8.3% (18)	3.2% (7)	2.3% (5)	218
f. Feigned acceptance (did not accept the idea, but pretended to)	**73.4% (160)**	18.8% (41)	6.9% (15)	0.9% (2)	0.0% (0)	218
g. Hidden sabotage	**94.5% (206)**	3.2% (7)	1.4% (3)	0.9% (2)	0.0% (0)	218
					answered question	218
					skipped question	97

One of the problems encountered with this question is in the weighting of the different choices. Is Passivity more of a negative behaviour than Tolerance? Should Reluctance be weighted more negatively than Passivity or Tolerance?

A second problem arose when viewing the mix of response choices. It would appear that the wording of the question caused quite a bit of confusion amongst the respondents, as there were a substantial amount of contradictory responses. Examples are reflected in Table 27.

Table 27: Contradictory responses to MO3

	a Enthusi-asm	b Cooper-ation	c Tolerance (wasn't happy but did not interfere)	d Passivity (did not get involved)	e. Reluctance (unwilling, didn't really want to get involved)	f Feigned acceptance (did not accept the idea, but pretended to)	g Hidden sabotage
1	Quite a lot	Quite a lot	Quite a lot	Quite a lot	Quite a lot	Quite a lot	Quite a lot
2	Quite a lot	Very Much	Very Much	Some	Some	Some	Quite a lot
3	Very Much	Very Much	None	Quite a lot	None	None	None
4	Very Much	Very Much	None	Quite a lot	None	None	None
5	Quite a lot	Very Much	Quite a lot	Quite a lot	None	None	None
6	Quite a lot	Quite a lot	Quite a lot	Quite a lot	None	None	None
7	Quite a lot	Very Much	Quite a lot	None	None	None	None
8	Quite a lot	Very Much	Quite a lot	None	None	None	None
9	Quite a lot	Quite a lot	None	None	None	None	None
10	Quite a lot	Very Much	None	None	None	None	None

Rows 9 and 10 reflect responses that make sense; respondents indicate positive behaviours with no negative behaviours. However:

- Rows 1 – 8 reflect contradictory responses that are difficult to understand and make sense of.
- Row 1: this user is either confused or just selected the choice to complete the survey as quickly as possible.
- Row 2: How is it possible that someone could be enthusiastic and cooperative, tolerant, and also engage in quite a lot of hidden sabotage?

- Row 3 + 4: These respondents are enthusiastic and cooperative, but also passive?

- Row 5 + 6: These respondents are enthusiastic and cooperative, but also tolerant and passive

- Row 7 + 8: These respondents are enthusiastic and cooperative, but also tolerant

Furthermore, given the abundance of literature and debate surrounding the concept of "Motivation", it is suggested that it would be better to change the name of this variable to Willingness or Resistance, and operationalise the construct in terms of resistance behaviours (T. Klaus & Blanton, 2010; T. Klaus et al., 2007). This is similar to what was attempted in MO4, which reads as follows:

> Which of the following applied to you during the implementation of the system?
>
> - I complained a lot
> - I tried to convince management not to implement the system
> - I took a long to provide any information that I was asked for
> - I did not want to change anything that I was currently doing because of the new system
> - I looked for ways around the system so that I did not have to change anything that I was doing before the system was implemented.
> - I avoided learning and using the new system as much as possible
> - I thought about finding another job
> - Other – please specify

The responses to this question were very interesting, particularly from those respondents who provided additional comments. In total, 90 respondents answered this question, the results of which are summarised in Figure 19.

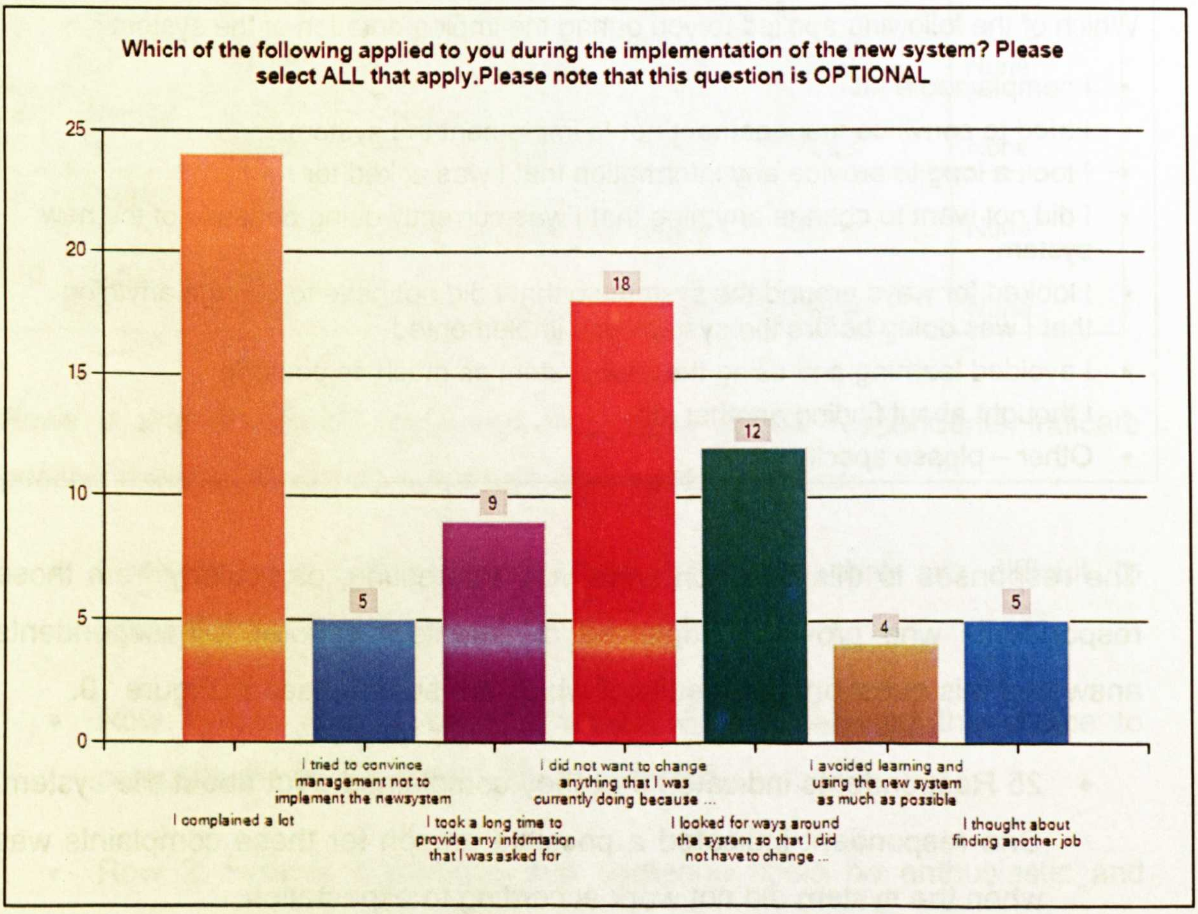
- 25 Respondents indicated that they complained a lot about the system. One respondent indicated a possible reason for these complaints was when the system did not work according to expectation.

- 18 Respondents indicated that they did not want to change their existing work practices, but as noted by one respondent, "we had to get used to it". Interestingly, only 12 respondents indicated that they looked for work-arounds to the system so that they did not have to change existing work practices - and only 5 of these respondents also indicated resistance to change.

- 2 respondents indicated high levels of resistance by selecting all the options available. They both noted that this resistance stemmed from high levels of satisfaction with the existing system, with one of the respondents noting that change was difficult because he/she was used to the old system

These responses provide possible reasons for unwillingness and could be used to create better questions for the main study.

Figure 19: Motivation Behaviours



Other interesting comments are as follows:

- "I was nervous". The respondent did not select any of the options provided, and therefore the behaviour that manifested as a result of this nervousness is unknown.
- "Continually requested training - with no response". Again, none of the options provided were selected, and therefore the behaviour that resulted is unknown.
- "I was reluctant for change but enjoy it now!" and "no one likes change but it was a GREAT thing we did this!". Once again, none of the options provided were selected.

However, this question was made optional, which was a mistake as only 90 out of the 267 respondents who completed the questionnaire answered this question. This question is a lot easier to code, as all the options refer to resistance / unwillingness and therefore can be coded as such.

In light of the above, the scale used in the pilot study to measure motivation was eliminated and replaced with a new scale measuring User Resistance. The findings of the pilot study in terms of the possible reasons for unwillingness was used to help to create these new questions, in conjunction with relevant items relating to resistance behaviours, such as those identified by Klaus et al (2007) and Klaus & Benton (2010).

7.5.3.7. Shared Understanding, Source Credibility and Arduous Relationship

The factor analysis identified that the three subscales measuring these three constructs loaded on a single factor. As discussed in section 7.5.2, this result can be interpreted in two ways:

(1) There is no discriminant validity between the items measuring these constructs and therefore the measures should be revised for the main study; or

(2) The three sub-scales are equally valid measures of a single underlying construct and therefore cannot be discriminated from each other within the context of the construct that they measuring, thus rendering revision of the scales pointless.

A review of the measurement items of each of the subscales to test for face validity revealed that item AR2 was adapted from an item that was used in a pre-existing instrument to measure Source Credibility. The factor analysis was repeated, with the AR2 item omitted, to determine whether this item had contaminated the loadings.

The results of the revised factor analysis revealed no changes to the number of factors extracted, nor to the loadings of the SU, SC and remaining AR items (see Appendix 3), thus confirming that no contamination occurred. Consequently, it is accepted that the scales SU, SA and AR are measuring a single underlying construct, and cannot be differentiated from each other.

This suggestion is supported by the literature if the barriers to the knowledge transfer process are understood through the lens of User Resistance. For example, it makes logical sense that a lack of shared understanding between the source and the user would enhance user resistance. Similarly, user perceptions of sources attempting to transfer unproven processes (unproven knowledge) would also enhance user resistance.

As discussed above, the "Motivation" construct, also a barrier to the knowledge transfer process, is now to be replaced by the "User Resistance construct. The results of the factor analysis therefore could be suggesting that the underlying construct that the scales are measuring is User Resistance.

7.5.3.8. Occupational Strength of Commitment (OCS)

The survey was administered during a company-wide retrenchment initiative. The occupational strength of commitment questions could have been perceived as a potential threat to job security, which could well have been heightened by the retrenchment initiative, resulting in respondents adjusting their responses to provide more "desirable" responses in order to reduce the perceived threat. The overall high scores for the respondent population could therefore be due to the perspective that this set of questions relates to job satisfaction and that a negative response would lead to job loss.

7.6. Summary

A pilot study of the survey instrument was conducted during June 2010, the objective of which was to test the reliability and validity of the instrument prior to administration of the main study. The study was completed in collaboration with a South African company that was completing its 5-year ERP implementation project.

The statistical analyses, in conjunction with a review of the instrument items for face validity exposed the following broad categories of weaknesses with nine of the 12 scales used in the research instrument, namely: (1) insignificant loadings, (2) cross loadings, (3) internal consistency, (4) ambiguity in phrasing, and (5) missing variables. Table 28 lists the scales, their identified weaknesses and the recommended revisions to the research instrument prior to the administration of the main study.

In the following chapter, the revisions that were necessary to correct these weaknesses prior to the administration of the main study are described in detail. Consequently it was necessary to correct these weaknesses by revising the research instrument prior to the administration of the main study. These revisions are described in detail in the following chapter.

Table 28: Research Instrument Revisions Required

Scale	Action	Description
OCS	Add items	To control for retrenchment bias and user perceptions of management initiatives
ACS	Rephrase	The opening paragraph only
UK	Revise	All items need to be revised due to insignificant loadings on all factors - need to increase applicability of measures
SC	None	Leave as is and await results of main study to determine loadings of other barriers. Perform 2^{nd} order factor analysis on all barriers to identify whether there is a single underlying construct
SU		
AR		
SA	Revise	Remove ambiguity in phrasing
PA	Revise	Remove ambiguity in phrasing
WPC	Revise and add items	Operationalisation of construct to be reviewed due to cross-loadings and poor internal consistency. Items to be added to explain possible contradictory responses.
QIU	Revise	Remove QIU6 and revise other items
MO	Replace	Replace with "User Resistance" construct
SP	Revise	All measures need to be revised to increase internal consistency

CHAPTER 8

LESSONS LEARNED

"Always watch where you are going. Otherwise, you may step on a piece of the Forest that was left out by mistake"

Winnie the Pooh - *Pooh's Little Instruction Book*

8.1. Introduction

The previous chapter presented the results of the pilot study that was undertaken to validate the research instrument. Weaknesses were identified, resulting in the need to revise the survey instrument prior to administration of the main study.

This chapter describes the revisions that were made to the survey instrument to rectify the identified weaknesses. The revision of the survey instrument also led to the adaptation of the research model. Section 8.2 discusses the revisions to the survey instrument. The changes made to the research model are discussed in section 8.3.

8.2. Revision of Survey Instrument

The revision of the research instrument was undertaken primarily by revisiting the literature, both in terms of re-examining papers already read as well as broadening the search for additional relevant articles.

As it was not feasible to undertake a second pilot study, new and revised survey items were tested on friends, colleagues and experts in the field.

8.2.1. Quality in Use

As discussed in sections 3.2.2 and 7.5.3.4, this construct was used to measure ERP system success, as it was seen to relate to the benefits of system use at the individual performance level. Quality in use was therefore operationalised in terms of the users' perceptions of how the system had affected their overall job performance. However, the additional literature reviewed highlighted a marked similarity of this construct to Moore & Benbasat's (1991) conceptualisation of the "Relative Advantage" construct.

Relative Advantage (RA) was originally conceptualised by Rogers (1995) in his Innovation Diffusion Theory work. Rogers' short definition of relative advantage is "the degree to which the innovation is perceived to be better than the idea it supersedes" (Rogers, 1995, p.212). However, it is more complex than the short definition implies, as the degree of relative advantage is often expressed as economic profitability, social prestige or other benefits (Rogers, 1995, p.212). He further identifies sub-dimensions of relative advantage, including "the degree of economic profitability, low initial cost, a decrease in discomfort, social prestige, a saving in time and effort, and the immediacy of reward" (Rogers, 1995, p.216).

Moore & Benbasat (1991) argued that within the business computing domain, the type of relative advantage that mattered most was usefulness in terms of the extent to which employing the innovation would contribute to improved job performance. This is because, within an organisational context, employees are generally rewarded for good performance through raises, bonuses and promotions (Van Slyke, Johnson, Hightower, & Elgarah, 2008). This is equally true within an ERP system context, and is in tune with the way in which ERP system success is defined for this study, that is, it is measured in terms of the benefits that accrue to the user in terms of their job performance as a result of system use (see section 3.2.2). From a user perspective, these benefits refer to enhanced task performance, such as increased speed, ease of task execution and increased task effectiveness.

This conceptualisation of Relative Advantage essentially reduces the construct to the equivalent of Davis's "perceived usefulness", which Moore & Benbasat

(1991) themselves suggested, could be a better name for this construct. Davis defined perceived usefulness as "the degree to which a person believes that using a particular system would enhance his or her job performance." (Davis, 1989, p.320) This definition is based on the definition of the word useful: "capable of being used advantageously" (Davis, 1989, p.320). A system high in perceived usefulness, therefore, is one for which a user believes that his or her performance will be enhanced. Perceived Usefulness is therefore an attitudinal measure of net benefits (Rai et al, 2002). This view is consistent with Seddon's (1997) conceptualisation of Net Benefits that proposed that perceived usefulness and user satisfaction are general perceptual measures of the net benefits of IS Use (Rai et al., 2002; Seddon, 1997). Consequently, the original Quality in Use construct identified for this study is renamed as Perceived Usefulness.

Davis's original 6-item short-form PU scale (reflected in Table 29 in italics) forms the basis for the operationalisation of this construct. To ensure that users were reporting on perceptions of actual usefulness during use of the system, rather than expected usefulness prior to use of the system, the future-tense orientation of Davis's (1989) items were adapted to present tense (Rai et al., 2002; Seddon, 1997)

PU2, PU4 and PU6 were rephrased to omit words such as "productivity", "performance" and "effectiveness", which were deemed to be confusing and ambiguous. PU7 was included in the initial scale created by Davis (1989) for PU but was not included in the short-form scale. It has been used by numerous other studies (for example Compeau et al., 2007; Moore & Benbasat, 1991; Park et al., 2007; Staples & Seddon, 2004), and included here as it was deemed especially relevant to the OCoP context of this study.

Table 29: Quality in Use / Perceived Usefulness Revised Item Scales

Pilot Study Questions		Revised Questions for Main Study	
QIU1	I am able to do my job better using the system	PU1	I am able to do my job better using the new system *I would find CHART-MASTER useful in my job.*
QIU2	I am able to do more work in the same amount of time using the system	PU2	I am able to perform tasks more quickly using the system *Using CHART-MASTER in my job would enable me to accomplish tasks more quickly.* *Using CHART-MASTER in my job would increase my productivity*
QIU3	Using the system has increased the quality of my work output	PU3	Using the system makes it easier to do my job *Using CHART-MASTER would make it easier to do my job.*
QIU4	I am able to complete all my tasks more accurately using the system	PU4	I am able to complete all my tasks more accurately using the system *Using CHART-MASTER would enhance my effectiveness on the job*
QIU5	I am more satisfied in my job since I have been using the system	PU5	I am more satisfied in my job since I have been using the system
QIU6	If you were told that the company was going back to the old system, which of the following best describes how you would respond? (Select ONE only) ▪ Over my dead body – this system is much better than the old one ▪ Over my dead body – I have invested far too much time and effort to go back to the old system now ▪ I know there are problems but we can fix it ▪ Take it and good riddance ▪ Other (please specify)	PU6	My job would be difficult to perform without the new system *Using CHART-MASTER would improve my job performance.*

	Pilot Study Questions		Revised Questions for Main Study
		PU7	Using the system gives me greater control over my work
			Using electronic mail gives me greater control over my work

8.2.2. Work Practice Compatibility

The pilot study results reflected that the scale items of Compatibility with Preferred Practices and Quality in Use loaded onto a single factor (see Section 7.5.1), suggesting a lack of discriminant validity. Other studies (for example Compeau et al., 2007; Karahanna et al., 2006; Moore & Benbasat, 1991) have reported similar findings, the reasons for which only became apparent as a result of the new information concerning the Relative Advantage / Quality in Use discussion above.

Within the context of his Innovation of Diffusion Theory, Rogers (1983, 1995) defined compatibility as the degree to which an innovation is perceived to be consistent with the existing values, past experiences and needs of the potential adopters.

However, Moore & Benbasat (1991) argue that there can be no advantage to an innovation that does not reflect an adopter's needs. Consequently, they posit that the Relative Advantage construct, viewed as synonymous with Davis's (1989) Perceived Usefulness construct, is confounded with "compatibility with needs". They therefore did not include compatibility with needs into their definition or operationalisation of the compatibility construct.

Despite Moore & Benbasat's intentional omission of the Compatibility with Needs construct in their operationalisation of their compatibility construct, they reported that all scale items for the compatibility and relative advantage items loaded onto a single factor. An examination of the scale items for their compatibility construct (see Table 30) reveals that two out of the three items seem to focus primarily on the Compatibility with Preferred Practices dimension.

Table 30: Moore & Benbasat's (1991) Compatibility Scale

Scale Item	Relates to
Using the system is compatible with all aspects of my work	General compatibility
Using the system fits well with the way I like to work	Preferences
Using the system fits into my work style	Preferences

Given that other studies (for example Compeau et al., 2007; Karahanna et al., 2006), including the pilot study conducted for this research, reported similar findings for the Compatibility with Preferred Practices and Relative Advantage constructs, Moore & Benbasat's (1991) findings are therefore not surprising.

Compeau et al. (2007) suggests that the reason why Compatibility with Preferred Practices and Relative Advantage show a lack of discriminant validity is because they both capture the Compatibility with Needs construct.

What is surprising, however, is that other studies reflected discriminant validity between the Relative Advantage construct and the other 3 subcomponents of the Compatibility construct. Compatibility with Existing Work Practices, Compatibility with Prior Experiences and Compatibility with Values could also be considered to capture user needs. However, both Compeau et al.'s and Karahanna et al's studies, as well as the pilot study reflect adequate discriminant validity for these subcomponents.

At its core, Relative Advantage is concerned with improving the current situation. Users ask the question "Will I be better off if I use this new technology?" Inherent in the relative advantage construct, therefore, is the notion of a comparison with the present way of doing things.

Prior knowledge and experience is one of the main mental anchors that people use to make sense of new things. Users can more easily understand new technology if it is compatible with previous experiences and practices, and therefore a new system that fits well with existing, desired or past practices may be more attractive than one that does not. Therefore, when considering the factors that influence the adoption of new technology, it is possible that the effect of compatibility on adoption is mediated by Relative Advantage, rather than subsumed by it. This would suggest that if an individual perceives the new technology to be compatible, they would be more likely to perceive the relative advantage of the new technology as well.

For this reason, Relative Advantage and Compatibility should remain separate constructs for the purposes of this research. In this way, it can be demonstrated whether Work Practice Compatibility and Relative Advantage (as operationalised in terms of Perceived Usefulness) are separate (ie WPC being an antecedent to RA (success) or whether these constructs are in fact one complex construct. This can provide an additional contribution to the extant literature by discussing an existing dilemma. When operationalising the constructs, it is important to ensure that there is no cross-contamination between the measurement items.

In light of this new information, it was deemed necessary to re-examine the operationalisation of all the constructs used in the research instrument to identify any additional confounded variables.

- Compatibility with Existing Practices – the pilot study results of the Cronbach Alpha scores reflected that scale item WPE04 be removed to bring the reliability of this scale to an acceptable level. This item was replaced with an item from Moore & Benbasat (1991) which was included in a scale reported to have high reliability.

- Compatibility with Past Experiences with Technology, originally excluded, is added back into the Compatibility construct. Originally, it was suggested that this dimension was subsumed by the ACS dimension (see section 5.4.1), however, this is not quite true. The theory on which the research model is based is that strength of commitment will increase resistance to new knowledge and practices, thus interfering with the knowledge transfer process and reducing the ability of the consultants and users to mutually adapt the system to suit the users' needs in terms of existing, past, preferred and imposed working practices. Karahanna et al define prior experience compatibility as "reflecting a fit between the target technology and a variety of users' past encounters with technology" (Karahanna et al., 2006, p.787). This definition is very similar to the aspect of Absorptive Capacity that deals with prior experience of systems, as conceptualised and operationalised by Park et al. However, it is not the same. Karahanna et al (2006) refer to the USE of the system, whereas Park et al (2007) refer to the prior knowledge of the user about the system – these are different stages of the ERP implementation life cycle. Knowledge transfer and adaptation occurs during implementation and therefore AC is required during this phase. Use occurs after implementation and this is when the effects of WPC are relevant for performance effects.

- Compeau et al's (2007) scale is used in the revised instrument because it appears to have higher face validity in the context of this research study than Karahanna et al's scale. Karahanna et al's questions refer to "business experiences" whilst Compeau et al's questions are more generically phrased in terms of "experiences", and can thus be interpreted as experiences with technology.

- Within the Occupational Community of Practice context, Compatibility with Values is replaced with Compatibility with Imposed Practices, as it relates to the values imposed by the regulating bodies of the communities of practice (see section 6.8.4.3). Cronbach Alpha scores in the pilot study were high for this scale, but the factor loadings were low and there were some cross-loadings. Consequently, the scale was revised: the first three items were reworded for better clarification, the fourth item was replaced with an item adapted from Karahanna et al's (2006) scale,

- The Compatibility with Preferred Practices dimension remains included in the model to test the Relative Advantage / Compatibility issue discussed above. To properly test this, it is necessary to add measures from other studies that have reported similar issues in an attempt to recreate the test. Therefore, the new scale for this dimension consists of four items: the 2 original items in the pilot study that reflected high alpha scores, and 2 additional items from the studies of Karahanna et al (2006) and Compeau et al (2007). The new items were reverse-coded in line with the original items from the pilot study to avoid the potential for introducing systematic error to the scale (as discussed in Section 6.8.1)

- Overall Work Practice Compatibility – This dimension was intended to be used to assess which of the four dimensions had the most impact on overall perceptions of compatibility. However, consistent with Moore & Benbasat's (1991) findings discussed above, WPO3 loaded together with Quality in Use and Compatibility with Preferred Practices, reflecting poor discriminant validity. Bearing in mind the conflicting data obtained in the pilot study, (as discussed in section 7.5.3.5), it was decided to replace the entire dimension with a set of questions that could provide explanations for user perceptions of compatibility. To this end, replacement questions were developed based on Davis's (1989) "Facets of Fit" (also referred to by Goodhue (1998) as Task-Technology-Fit components of Need). These factors were found to explain 70% of variance in performance (Kositanurit et al., 2006). Replacement questions were adapted from other researchers' operationalisations of Davis's "Facets of Fit" constructs (for example Staples & Seddon, 2004; Sun et al., 2009)

Table 31 presents the original and revised items for the Work Practice Compatibility scale.

Table 31: Work Practice Compatibility Revised Scales

	Pilot Study Questions	Revised Questions for Main Study
COMPATIBILITY WITH EXISTING PRACTICES		
WPE2	To use the system, I did not have to make significant changes to the tasks that I was doing before the system was implemented	To use the system, I did not have to make significant changes to the tasks that I was doing before the system was implemented
WPE3	To use the system, I did not have to make significant changes to the way I was doing my tasks before the system was implemented	To use the system, I did not have to make significant changes to the way I was doing my tasks before the system was implemented
WPE4	The system provides me with the same information that I had before the system was implemented	Using the system is completely compatible with what I was doing before the system was implemented

	Pilot Study Questions	Revised Questions for Main Study
COMPATIBILITY WITH PREFERRED PRACTICES		
WPP3	The system allows me to work in the way that I want	The system allows me to work in the way that I want
WPP2	The system provides me with the exact information that I would like to have to do my job	The system provides me with the exact information that I would like to have to do my job
WPP1		Using the system fits well with the way I like to work
WPP4		Using the system fits my preferred method for doing my job
COMPATIBILITY WITH IMPOSED PRACTICES		
WPI	The system allows me to comply with the regulations, rules and policies that are required in doing my job	Using the new system, I can still do my job the way I was taught during my formal training or apprenticeship (trade school, college, university)
WPI2	The system allows me to comply with the work practices that I was taught during my formal training for my job (at trade school, college, university)	Using the new system to do my job allows me to follow all the rules, regulations and policies that are required within the company
WPI5	The system provides me with the exact information that I am expected to provide to other members of my company	Using the new system to do my job, I can still comply with the regulations, rules and policies that are required outside of the company
WPI6	The system fits with the unique requirements of the organisation	Using the system corresponds with my beliefs about how I should perform my job
COMPATIBILITY WITH PAST EXPERIENCES WITH TECHNOLOGY		
WPT1		Using the system is a new experience for me
WPT2		Using the system is not similar to anything that I have done before
WPT3		Using the system is different from other experiences that I have had
WPT4		I lack experience when it comes to things like using the system.
OVERALL WORK PRACTICE COMPATIBILITY / FACETS OF FIT		
WPO2	The system has resulted in flawed or defective work processes	
WPO3	The system is compatible with all aspects of my work	
WPO4	The system is missing critical information that is very useful to me in my job	

	Pilot Study Questions	Revised Questions for Main Study
		Which of the following have you experienced since using the system to do your job? (Please select ALL that apply) • The data provided by the system is outdated for my purposes • The system provides me with data that is too summarised for my needs • The system provides me with data that is too detailed for my needs • The exact definition of data fields relating to my tasks is hard to find out • Data that would be useful to me are unavailable because I don't have the right authorisation • Getting authorisation to access data that would be useful to my job is time consuming and difficult • The system is subject to frequent system problems and crashes • It is hard to learn how to use the system • The information provided by the system does not meet my needs • The system provides faulty information • I now have to copy data from the system into a spreadsheet so that I can get it into the format that I want • My tasks are sometimes or frequently delayed because I have to wait for data from the system • The description of the functions / commands displayed on screen is difficult to understand. • The function/command names of the system are difficult to remember • The system is missing functionality that I need to do my job • I see myself as a less valuable employee because of the way the system has redefined my work role • None of the above • Other (please specify)

8.2.3. Occupational Commitment

Participants of the pilot study were informed of the survey by the company's IT management, which could have been perceived as a management initiative despite the guarantees provided by the researcher of data confidentiality and anonymity. In addition, the study was administered during a company retrenchment initiative, which could have exacerbated the perception of a management initiative to identify potential candidates for retrenchment, and thus a potential threat to their job security.

Had the same data collection methods be planned for use in the main study, additional items would need to be included in the research instrument to control for current retrenchment initiatives and their effects on reported occupational strength of commitment. This would allow for a comparison to be done between respondents who are employed by companies that were undergoing retrenchment at the time of the survey and those that were not. In addition, it would be necessary to establish how the respondent heard about the survey, to determine whether respondents may be viewing the survey as independent of their company or as a management initiative.

However, the planned data collection methods for the main study were quite different to those used in the pilot study. As will be discussed in section 9.2, potential participants were informed of the survey via persons, forums and media external to their organisations, thus eliminating the potential for such perceptions. As a result, no changes were deemed necessary to the research instrument as a result of the OCS item scale.

8.2.4. Absorptive Capacity

Absorptive Capacity is operationalised in terms of two dimensions, namely Absorptive Capacity of System Knowledge and Absorptive Capacity of Work Domain Knowledge.

8.2.4.1. Absorptive Capacity – System Knowledge

The opening paragraph of this set of questions was rephrased to explicitly refer to the participants' knowledge of similar systems prior to the introduction of the ERP system into their organisation. This rephrasing was believed to reduce the potential for respondents interpreting the question in terms of any training that they may have received on the system during the system implementation process.

A review of the individual items in this scale also led to a refinement of item 3 (ACS3). The pilot study question was phrased "I understood the system well enough to recognise any inadequacies in the system". This phrasing could have been interpreted by respondents to refer to a broad spectrum of inadequacies including programming faults, technical errors and flawed or defective work processes outside the respondent's task domain.

As discussed in 4.3.2.3, Absorptive Capacity has been defined as the users' ability to learn to use the ERP system effectively (Park et al., 2007, p.301). This requires technical knowledge of the system in order to apply it when conducting tasks. Thus, users' learning capacity is affected by their prior knowledge of the technical aspects of the system, and their ability to understand and absorb the work practices that are required to be performed. It is therefore not necessary for users to understand technical aspects of the system outside of their own job and tasks in order for them to use the system effectively. Consequently, it was deemed necessary to qualify this question by explicitly referring to the ability to identify inadequacies relevant to the respondent's job and tasks.

Table 32 reflects the revisions to this item scale. Changes are highlighted in bold.

Table 32: ACS Revised Item Scales

	Pilot Study Questions	Revised Questions for Main Study
	Before the system was implemented	Before the system was **introduced into the company**
ACS1	I understood the basic concept and functions of systems like this	I understood the basic concept and functions of systems like this
ACS2	I understood the system well enough to be able to do my job effectively	I understood the system well enough to be able to use it to do my job effectively
ACS3	I was able to recognize inadequacies in the system	I understood the system well enough to recognise any inadequacies in the system **relevant to my job and tasks**

8.2.4.2. Absorptive Capacity – Work Domain Knowledge

As discussed in Section 7.5.3.2 the original questions were difficult to code and were therefore left out of the pilot study analysis. The revised scale items, reflected in Table 33 are based on Szulanski's (2003) original scale for this construct, and adapted to suit the context of this study.

Table 33: ACW Revised Item Scales

	Pilot Study Questions	Revised Questions for Main Study
ACW1	Which of the following best describes you? (Please select ONE only) ▪ My occupation / job requires a formal degree / training course / apprenticeship which I have obtained. ▪ Although my occupation / job does not require any formal qualifications, I have completed one or more relevant courses ▪ I am in the process of completing a formal degree / training course / apprenticeship with the expectation of obtaining a higher position within my current line of work ▪ I am in the process of completing a formal degree / training course / apprenticeship with the expectation of moving to a different line of work ▪ I have completed a formal degree / training course / apprenticeship for a job that is different to the one that I am currently employed to do ▪ None of the above ▪ Other (please specify)	I have completed, or am in the process of completing, a training course or apprenticeship programme relevant to my occupation / line of work
ACW2	You keep up to date of the latest developments in your occupation / job through... (Please select ALL that apply) ▪ Subscription to journals / trade magazines ▪ Membership of online discussion forums / groups ▪ Attendance at conferences	I keep up to date with the latest developments in my occupation / line of work

	Pilot Study Questions	Revised Questions for Main Study
	▪ Informal discussions and / or get-togethers with colleagues from other companies ▪ None of the above ▪ Other (please specify)	
ACW3	Do you belong to an association relevant to your occupation / job title, eg CIS, PAAB, Salesmen Association, Truck Driver's Association	Do you belong to an association relevant to your occupation / job title, eg CIS, PAAB, Salesmen Association, Truck Driver's Association
ACW4		I understand my job well enough to effectively use the new system
ACW5		In the past, I have used similar business processes to the ones that are included in the new system

8.2.5. Unproven Knowledge

To correct the lack of internal consistency, convergent and discriminant validity identified by the pilot study results (see section 7.5.1 and 7.5.2), the items for this scale were revised completely. Items 1 and 2 were adapted from Compeau e al (2007), and item 3 was adapted from Szulanski's (2003) original scale for this item. The original and revised scale items for this construct are reflected in Table 34.

Table 34: Unproven Knowledge Revised Item Scales

	Pilot Study Questions	Revised Questions for Main Study
	Before the system was implemented	Before the system was introduced into the company
UK1	I thought that the system would be able to support every task that I needed to perform	I knew of many people outside my organisation who were successfully using systems like this one
UK2	I knew of other people, with similar job titles as me, working in other companies, who had successfully used systems like this in the past	I knew of many of my peers in other organisations who were successfully using systems like this one
UK3	I was expecting the system to increase my job effectiveness	I had solid proof that the new system was going to contribute significantly to my job performance

8.2.6. System Adaptation / Process Adaptation

To remove the ambiguity in the phrasing of the questions for both these scales, the opening paragraph of each set of questions was altered to explicitly refer to the implementation team, thus expressing the intended meaning of the question.

In addition, the phrasing of the first question of both scales (SA1 and PA1) was altered due to the feedback obtained from informal testing of the revised questions. The feedback indicated that difficulty was being experienced in differentiating between the first and second questions of each of the scales (SA1 and SA2 and PA1 and PA2). The first question in each scale was aimed at what tasks were being done, whilst the second was aimed at how these tasks were being executed. Feedback indicated that both questions were asking the same thing. Therefore, the first question was rephrased to refer to assigned tasks, thus clarifying the differences between the two aspects.

Re-examination of the Process Adaptation questions suggested a possible cross-contamination with the Existing Work Practice questions. However, it was concluded that the process adaptation questions referred to user perceptions during the implementation phase, whilst the work practice questions referred to the outcomes of the system during actual use. Therefore it was concluded that these two items were distinct and could both be included in the research instrument.

Table 35 provides a comparison between the questions used in the pilot study and the revised questions now incorporated into the main study research instrument. Changes are highlighted in bold.

Table 35: System and Process Adaptation Revised Item Scales

	Pilot Study Questions	Revised Questions for Main Study
	SYSTEM ADAPTATION	
	While the new system was being implemented, attempts were made to change the system so that it better matched:	While the new system was being implemented, **the implementation team tried to change the system so that it better matched**
SA1	The tasks that I was doing before the system was implemented	The tasks that I was **assigned** before the system was implemented
SA2	The way that I was doing my tasks before the system was implemented	The way that I was doing my tasks before the system was implemented
SA3	The that I was taught to do my job during my formal training (trade school, college, university)	The way that I was taught to do my job during my formal training (trade school, college, university)
SA4	The way that I prefer to work	The way that I prefer to work
SA5	The rules, regulations and policies that I have to comply with in my job	The rules, regulations and policies that I have to comply with in my job
	PROCESS ADAPTATION	
	While the new system was being implemented, attempts were made to change:	While the new system was being implemented, **the implementation team tried to change the way I work, in terms of:**
PA1	The tasks that I was currently doing, to fit in with the new system	The tasks that I was currently **assigned, in order to** fit in with the new system
PA2	The way that I was currently doing my tasks, to fit in with the new system	The way that I was currently doing my tasks, **in order to** fit in with the new system
PA3	The way that I was taught to do my job during my formal training (trade school, college, university), to fit in with the new system	The way that I was taught to do my job during my formal training (trade school, college, university), **in order to** fit in with the new system
PA4	The way that I prefer to work, to fit in with the new system	The way that I prefer to work, **in order to** fit in with the new system
PA5	The rules, regulations and policies that I have to comply with in my job, to fit in with the new system	The rules, regulations and policies that I have to comply with in my job, **in order to** fit in with the new system

8.2.7. Motivation

As discussed in section 7.5.3.6, the items used for this construct led to both coding difficulties as well as conflicting responses and therefore was excluded from the pilot study analysis. Szulanski's (2003) original conceptualisation of this construct pertains to the user's willingness to learn, apply and integrate new knowledge and processes, or put another way, their resistance to the new system and its processes. Therefore, as was suggested in section 7.5.3.6, this construct is now replaced with User Resistance, and is operationalised in terms of both perceptions (Bhattacherjee & Hikmet, 2007; Hirscheim & Newman, 1988; Sheth et al., 2000) and behaviours (T. Klaus & Blanton, 2010; T. Klaus et al., 2007).

The original and revised scale items for the Motivation / Resistance constructs are reflected in Table 36. Items RES1 and RES2 were adapted from Sheth,et al (2000), RES3 was adapted from Battacherjee & Hikmet (2007), RES4 – RES6 are adapted from Hirscheim & Newman (1998), and RES7 was adapted from Klaus et al (2007).

Table 36: Resistance Scale

Pilot Study Questions		Revised Questions for Main Study	
MO3	To what extent did you react with each of the following to the introduction of the system? Please give a rating for EACH of the reactions below • Enthusiasm • Cooperation • Tolerance • Passivity • Reluctance • Feigned acceptance • Hidden sabotage • Outright rejection	RES1	I was happy with the old system and did not see the need for a new system
MO1	I was reluctant to accept the new ways of working that came with the system	RES2	I feared that the new system was going to require substantial changes to my existing workflows, practices and routines

Pilot Study Questions		Revised Questions for Main Study	
MO2	Overall, I looked forward to implementing and using the system	RES3	I feared that I might lose control over my job once the new system was implemented.
		RES4	I feared that I would lose status within the organisation once the new system was implemented
		RES5	I feared that the implementation of the system would result in me being transferred away from my colleagues
		RES6	I feared that I would not be able to acquire the new skills that were needed to use the new system or to perform my new tasks
		RES7	Which of the following applied to you during the implementation of the new system? Please select ALL that apply • I complained a lot • I tried to convince management not to implement the new system • I took a long time to provide any information that I was asked for • I looked for ways around the system so that I did not have to change anything that I was doing before the system was implemented • I avoided using and learning the new system as much as possible • I thought about finding another job • None of these applied to me • Other – please specify)

8.2.8. Summary

The revised literature review resulted in some considerable changes to the constructs and their operationalisation. Motivation was replaced with Resistance, and Quality in Use was replaced with Perceived Usefulness.

Compatibility with Past Experiences with Technology, originally considered to be redundant, was reinstated as a separate dimension of work practice compatibility.

8.3. Refinement of Research Model

The inclusion of additional constructs and the omission of existing constructs required that the research model and related hypotheses be revised to reflect these changes. The revised research model is provided in Figure 20, reflecting the following changes:

- The inclusion of Compatibility with Past Experiences with Technology (WPT) led to the addition of the following additional hypotheses

H1-4	Increased perceptions of WPT will enhance perceptions of perceived usefulness
H2-7	Process adaptation to suit the Best Practices embedded within the system will decrease perceptions of compatibility with prior technological experience
H2-8	System adaptation to prior technological experience will enhance perceptions of compatibility with prior technological experience
H3-4	Increased resistance will decrease perceptions of compatibility with prior technological experience

- The replacement of the Motivation construct with the Resistance construct, and the Quality in Use construct with the Perceived Usefulness construct led to the revision of the corresponding hypotheses by simple replacement of the relevant wording:

- The inclusion of the facets of fit items did not affect hypotheses as these were used to gain a deeper insight into the reasons for perceptions of compatibility, that is, for explanatory purposes only.

8.4. Summary

This chapter discussed the lessons learned from the pilot study and the resultant changes that were made to both the survey instrument and the research model.

Changes were made to the constructs and their operationalisation. The Motivation construct was replaced with Resistance, and Quality in Use was replaced with Perceived Usefulness. Compatibility with Past Experiences with Technology, originally considered to be redundant, was reinstated as a separate dimension of Work Practice Compatibility. The inclusion of this sub-dimension led to the addition of hypotheses relating to the relationships between Compatibility to Past Experiences with Technology, System Adaptation, Process Adaptation and Perceived Usefulness.

The revised survey instrument was deemed appropriate for use in the administration of the main study. The implementation and results of the main study are the focus of the following chapter.

Figure 20: Revised Research Model

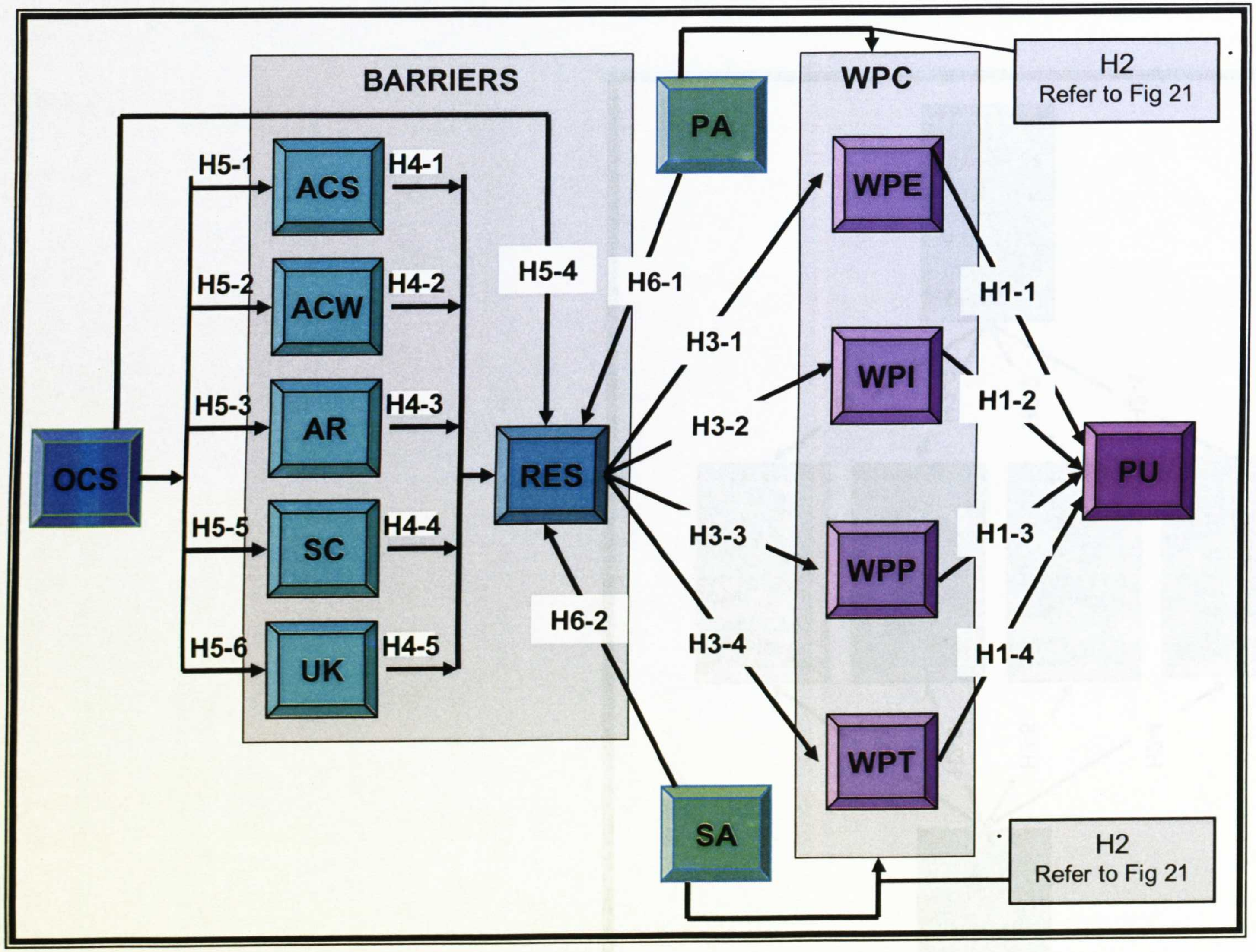
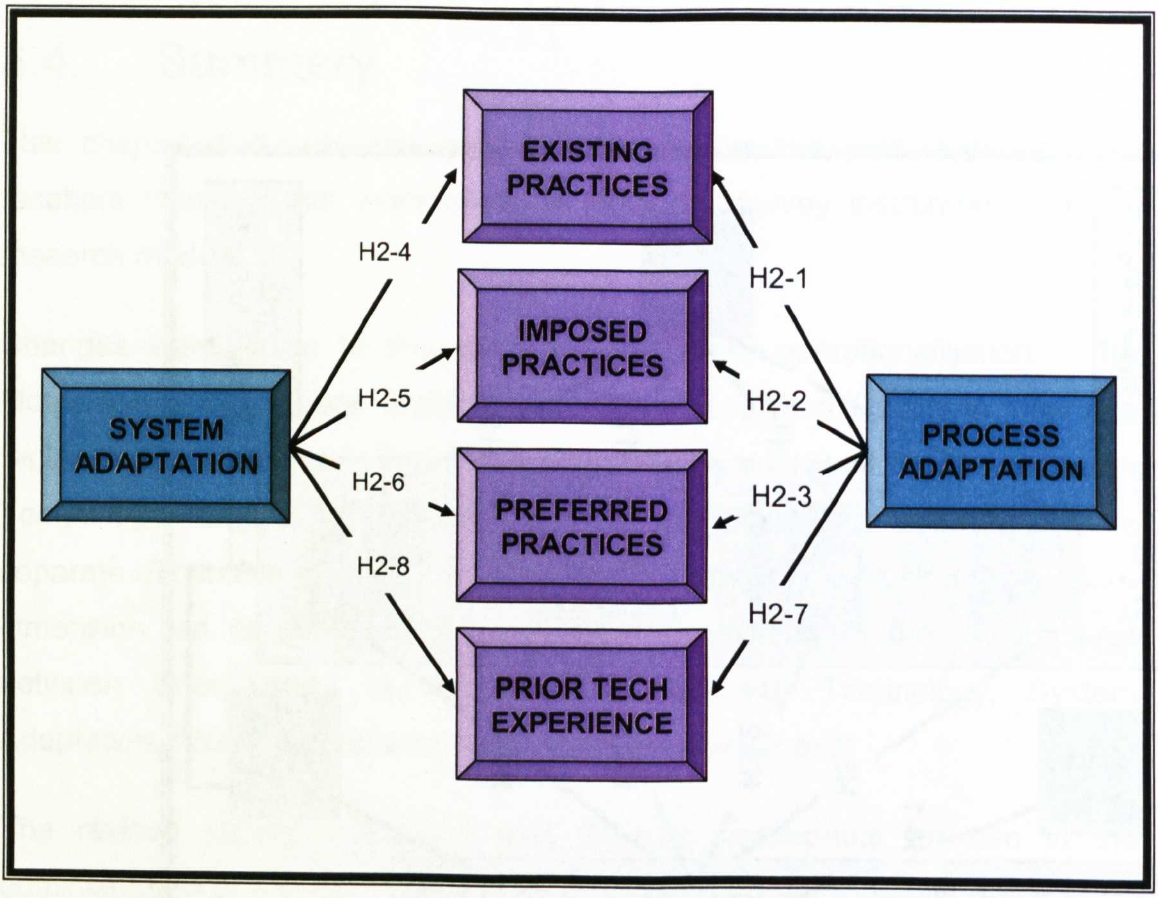


Figure 21: Revised Model - Relationships between Adaptation and WPC



CHAPTER 9

THE MAIN STUDY

"When you are a Bear of Very Little Brain, and Think of Things, you find sometimes that a Thing which seemed very Thingish inside you is quite different when it gets out into the open and has other people looking at it."

Winnie the Pooh - *The House at Pooh Corner*

9.1. Introduction

After considerable revisions to the survey instrument and research model based on the findings of the pilot study, the main study was implemented between November 2011 and June 2012.

The methods used to collect the data and overcome the problems that arose during the collection phase are described in section 9.2. This is followed by an analysis of the characteristics of the respondents (9.3).

Section 9.4 presents the results of the data analysis, beginning with the assessment of the measurement model (9.4.1), in order to establish the validity and reliability of the revised instrument and measures. Thereafter, the structural model was assessed in order to determine which hypotheses were supported by the data (9.4.2). The chapter concludes with an examination of the total effects of the structural relationships, in keeping with the hypothesized mediated relationship between occupational strength of commitment and ERP success.

Some of the hypotheses were supported, whilst others were not. Of particular interest was the amount of variance explained in the Perceived Usefulness, Work Practice Compatibility and Absorptive Capacity of Work Domain constructs.

9.2. Data Collection

As discussed in Section 6.3, the collaboration secured with the consulting company ConCo was unexpectedly and irrevocably withdrawn by the company a week prior to the scheduled administration of the main study. This was a considerable setback because:

- no backup plan had been put in place as ConCo had signed a Non Disclosure Agreement, and had given no indication in the two years that followed the signing that there was any kind of problem brewing;
- the only other direct source of participants available to the researcher had been used for the pilot study;
- the timing so close to the festive season meant that there was little hope of garnering support from vendors or other consulting companies with whom no previous relationships had been established before the end of January;
- it was doubtful that other vendors or consulting companies would be prepared to collaborate given the confidentiality issues that ConCo had cited; and
- the submission deadline was 8 months away.

In the absence of a readily available sampling frame, four complementary data collection methods were undertaken. The first method, previously not considered, was placing advertisements for respondents on a variety of social networking forums. These included general forums focused primarily on ERP issues, vendor-specific ERP user forums, and general information technology discussion forums.

The second was joining related organisations such as BCS, CILT, IOM and APICS and requesting assistance from their members. These organisations were very helpful in posting appeals to their members on their newsletters. In addition, appeals were posted on all the corresponding discussion forums in LinkedIn.

Thirdly, collaboration was secured with an on-line research company, Technology Evaluation Centers (www.technologyevaluation.com) who published an article about this research and offered all participants free access to their evaluation software. The article is available at http://blog.technologyevaluation.com/blog/2011/02/17/erp-fail-when-best-practices-meet-real-life/.

Finally, collaboration was secured with an expert in the Governance of Information Technology discipline, who sent out numerous appeals for respondents to the survey, both via email and in his monthly newsletters

These four approaches served to restrict appeals to a relevant sample population (Schmidt, 1997). Despite the proliferation of appeals that were sent out, it took more than 6 months to obtain a sufficient number of valid responses for statistical analysis purposes.

9.3. Sample

In total, 340 responses were obtained. Despite the request that only ERP end users complete the survey, 166 of the responses came from information technology specialists such as IT managers, Business Analysts, ERP Consultants, and ERP Developers. Use was made of the Job Title, Department and Industry fields to identify non end-user respondents. Thus for example, a respondent indicating that their job title was "Analyst", with "Information and Communications Technology" as their department, was considered as an information systems specialist and not an end user. However, a respondent indicating that their job title was "Analyst", but selecting "Management" as their department, and selecting any industry other than Information Systems, was considered as a bona fide end user.

Of the remaining 174 responses, 64 responses had missing values, leaving a total of 110 valid responses for analysis purposes. The general demographic characteristics of the sample are reflected in Table 19.

Table 37: Main Study Sample Characteristics

Criterion	Level	No	Total
Education			110
	High School or Lower	17	
	Trade School	6	
	Associate Degree	15	
	Bachelors Degree	34	
	MBA	9	
	Masters Degree	24	
	PhD	5	
Gender			110
	Male	74	
	Female	35	
	Unspecified	1	
Age Group			110
	21 – 27	9	
	28 – 34	16	
	35 – 41	21	
	42 – 48	23	
	49 – 55	27	
	≥ 56	14	
Occupation Type			110
	Accounting & Finance	26	
	Administration & Legal	8	
	HR	3	
	Info Sys & Tech	20	
	Management	5	
	Purch, Inv, W/h & Dist	15	
	Production	15	
	Sales, Marketing & Customer Service	8	
	Training & Education	4	
	Other	6	
ERP software			110
Tier I	SAP	26	37
	Oracle	11	
Tier 2	Microsoft Dynamics	32	46
	Infor	6	
	Lawson	2	
	Epicor	2	

Criterion	Level	No	Total
	Sage	4	
Tier 3	NetSuite	1	27
	Invensys	1	
	Consona	1	
	Exact	1	
	Other	23	
Length of time using the system			110
	0 – 6 Months	23	
	6 – 12 Months	13	
	12 -24 Months	24	
	2 – 5 Years	30	
	> 5 Years	20	
Number of years in current line of work			110
	< 1 Year	3	
	1 - 2 Years	3	
	2 - 3 Years	4	
	3 - 4 Years	1	
	4 - 5 Years	9	
	5 - 10 Years	25	
	11 - 15 Years	20	
	15 - 20 Years	13	
	> 20 Years	32	
Country			110
North America and Canada	United States	25	31
	Canada	6	
South America	Brazil	1	5
	Chile	1	
	Croatia	2	
	Ecuador	1	
Southern Africa	South Africa	27	29
	Angola	1	
	Zimbabwe	1	
United Kingdom		12	12
Rest of Europe	Belgium	2	10
	France	1	
	Germany	1	
	Greece	1	
	Italy	1	

Criterion	Level	No	Total
	Netherlands	1	
	Romania	2	
	Saint Helena	1	
Australia and New Zealand		8	8
Eastern Countries	Bosnia and Herzegovina	1	10
	India	4	
	Indonesia	1	
	Jordan	1	
	United Arab Emirates	3	
Far Eastern Countries	China	2	5
	Philippines	1	
	Singapore	2	
Use of Consultants during Implementation			110
	Yes	84	
	No	27	
	Did not know	5	

As reflected in Table 37, there is a good representation of different countries, different ERP systems and age group ranges.

9.4. Results

In keeping with the sample size rules (discussed in section 6.5.1.2), the sample size of 110 obtained for this study was adequate for PLS-SEM. As reflected in Figure 20, the largest number of structural paths directed at a latent construct amounted to 8 (the Resistance construct). Therefore, the minimum sample size required for a PLS-SEM analysis is 80 (10 times the largest number of structural paths directed at any latent construct in the model: in this case, 10 x 8) (Haenlein & Kaplan, 2004; Hair et al., 2011).

Data was therefore assessed using SmartPLS version 2.0 M3 (Ringle, Wende, & Will, 2005). A PLS-SEM assessment typically consists of two steps that allows for the separate and successive assessment of the measurement model and the structural model (Hair et al., 2011). The objective of the measurement model assessment is to evaluate whether the measures sufficiently represent the constructs being tested. If this is found not to be the case, then there is no point in using those measures to examine the structural relationships between the constructs, which is the objective of the structural model assessment. This two-step process therefore determines the validity of the constructs, which in turn determines whether or not the structural model assessment should be undertaken.

9.4.1. The Measurement Model

There are three important measurement model issues that could seriously influence the validity of the results (Freeze & Raschke, 2007; MacKenzie, Podsakoff, & Jarvis, 2005). These are (1) model misspecification, (2) identification, and (3) construct validation. Each of these, together with the steps taken to overcome or reduce their potential negative influence on the results, is discussed next.

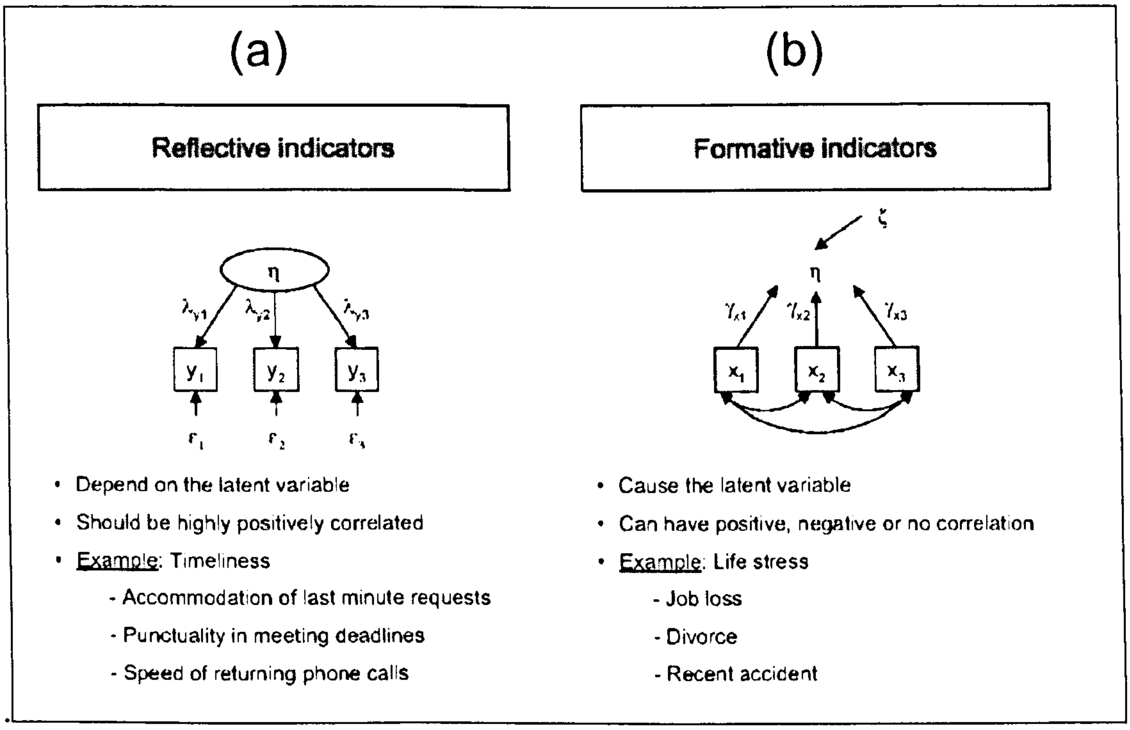
9.4.1.1. Model Misspecification

Model misspecification refers to the direction of the relationship between the measures and the constructs (Freeze & Raschke, 2007). The relationship between these can flow in two directions: either from the construct to the measure; or from the measure to the construct. When the direction of the relationship is from the construct to the measures, this is known as reflective measures (Figure 22a), or effects indicators. It is said that the indicators or measures are influenced by the latent variables. In this case, the measurement models that validate these measures and their constructs are referred to as reflective models (Haenlein & Kaplan, 2004; Henseler et al., 2009).

In contrast, measures that influence the construct are known as formative measures or causal indicators. The direction of the relationship between the measures and the construct is from the measures to the construct (Figure 22b). This type of construct is often referred to as a combination or composite variable, meaning that the measures cause the construct and that the construct is fully derived by its measurement. The measurement models that validate these measures and their constructs are known as formative models.

Misspecification of the direction of the relationship between the measures and the construct thus occurs when a construct is modelled as reflective instead of formative or vice versa. This can lead to Type I and Type II errors in the results of the structural model.

Figure 22: Reflective and Formative Indicators
(Source: (Haenlein & Kaplan, 2004, p. 289))



Based on the practical guidelines and examples provided in the literature (Chin, 1998b; Freeze & Raschke, 2007; Haenlein & Kaplan, 2004; Jarvis, MacKenzie, & Podsakoff, 2003; MacKenzie et al., 2005), all constructs in the research model were modelled as reflective; they all describe a personality trait or attitude (Haenlein & Kaplan, 2004); in addition, it was expected that for each construct, if one of the items suddenly changed in a particular direction, the others would change in a similar manner (Chin, 1998b); and dropping an indicator would not alter the conceptual meaning of the construct (Jarvis et al., 2003)

9.4.1.2. Identification

Identification refers to measurement models that have no unique solution (Freeze & Raschke, 2007). For reflective models, a necessary condition for identification is the rule of three: that is, that each construct has a minimum of three measures or indicators. This allows for the covariance amongst the measures to be used to estimate the factor loadings, and thus the construct can be said to be identified by its own indicators. As reflected in Table 41, all constructs except one in the final model comprised of three or more measures.

9.4.1.3. Construct Validity

Reflective indicators are expected to have a high correlation with each other as they are all dependent on the same unobservable variable (Haenlein & Kaplan, 2004). Reflective constructs therefore imply the assumptions of classical test theory; as a result the adequacy of the measurement model is determined by examining internal consistency and convergent and discriminant validity (Karahanna et al., 2006; Ko et al., 2005)

Internal consistency is assessed through composite reliability and/or Cronbach's Alpha coefficient, as well as by examining the loadings of each indicator on its respective construct (Hair et al., 2011; Karahanna et al., 2006; Ko et al., 2005). Composite reliability is similar to Cronbach's Alpha, in that values above 0.60 for exploratory research are considered acceptable. Unlike Cronbach's Alpha, composite reliability does not assume that all indicators are equally reliable, making it more suitable for PLS-SEM, which prioritizes indicators according to their reliability during model estimation. All constructs meet the required minimum of 0.60 for both Cronbach Alpha and Composite Reliability, as reflected in Table 38.

Indicator loadings on their respective constructs should be higher than 0.70. Table 40 presents the indicator loadings, reflecting that OCS1, ACW2 and ACW3, AR3, RES1 and RES7 did not meet the required loading of 0.70. Generally speaking, indicators with loadings between 0.40 and 0.70 should only be removed from the scale if such removal results in an increase in composite reliability above the suggested threshold, or increases the validity of the construct (Hair et al., 2011). All five of these items were removed; even though the removal of AR3 violated the rule of three for model identification (see 9.4.1.2), it was necessary for discriminant validity purposes as AR3 was loading equally highly on both the SU and SC constructs, and OCS1 was cross-loading on the ACW construct. In addition, the pilot study results reflected that OCS1 loaded substantially lower than the other indicators of the construct, corroborating the results of the main study and adding further support to the decision to remove this item from the model. The revised Cronbach's Alpha and Composite Reliability results are shown in Table 39, reflecting that all variables meet the requirement of being larger than 0.60. Thus, internal consistency of the model is established.

Convergent validity is assessed by examining the average variance extracted (AVE). AVE is computed by adding the squared factor loadings divided by number of factors of the underlying construct (Teo, 2009). The AVE of each construct should be higher than 0.50, meaning that the latent variable explains more than half of its indicators' variance. Prior to removing the problematic variables, the AVE of ACW did not meet this requirement, as reflected in Table 38. However, after removal of the problematic items ACW2 and ACW3, the ACW construct met this criterion, as did all the other constructs, as shown in Table 39. Thus, convergent validity of the model is established.

Table 38: Measurement Model Statistics

	AVE	Composite Reliability	Cronbachs Alpha
ACS	0.84887	0.943977	0.915058
ACW	0.402903	0.755145	0.625748
AR	0.625604	0.831219	0.688087
OCS	0.780307	0.954375	0.939645
PA	0.672509	0.910685	0.880304
PU	0.834496	0.97238	0.966528
RES	0.587504	0.905044	0.870729
SA	0.740253	0.934277	0.911882
SC	0.74238	0.920013	0.888344
SU	0.799733	0.922861	0.874122
UK	0.762744	0.906008	0.851570
WPE	0.82236	0.932806	0.891774
WPI	0.780523	0.934177	0.905671
WPP	0.885217	0.96857	0.956397
WPT	0.674978	0.89166	0.853928

Table 39: Revised Measurement Model Statistics

	AVE	Composite Reliability	Cronbachs Alpha
ACS	0.846708	0.943086	0.915058
ACW	0.607652	0.822258	0.674703
AR	0.858945	0.924094	0.838045
OCS	0.87127	0.971278	0.962867
PA	0.669479	0.909457	0.880304
PU	0.834496	0.97238	0.966528
RES	0.754009	0.938178	0.915491
SA	0.740337	0.934308	0.911882
SC	0.741005	0.919457	0.888344
UK	0.763177	0.906206	0.85157
WPE	0.822392	0.932818	0.891774
WPI	0.780563	0.934194	0.905671
WPP	0.885213	0.968569	0.956397
WPT	0.677382	0.89275	0.853928

Table 40: Cross Loadings and Indicator Reliability

	ACS	ACW	AR	OCS	PA	PU	RES	SA	SC	SU	UK	WPE	WPI	WPP	WPT
ACS1	0.9155	0.4710	0.3216	0.4436	0.0132	0.1114	-0.2266	0.1297	0.1970	0.2722	0.5244	0.3127	0.3572	0.2464	0.4386
ACS2	0.9284	0.4243	0.3243	0.2692	0.0399	0.1415	-0.2101	0.2162	0.2158	0.2981	0.5672	0.3394	0.3641	0.3067	0.4083
ACS3	0.9200	0.4113	0.2844	0.2213	0.0909	0.0874	-0.1959	0.1961	0.1610	0.2382	0.5711	0.3133	0.3456	0.2757	0.3920
ACW1	0.2569	0.7424	0.1064	0.5311	-0.0388	0.0521	-0.1382	0.0208	0.1397	0.0462	0.1783	0.0379	0.1579	0.1378	0.1904
ACW2	-0.0314	0.3673	-0.0336	0.2454	0.1095	0.0489	0.0593	-0.0044	0.0329	-0.0299	-0.0359	-0.0797	-0.0225	-0.0125	-0.1380
ACW3	0.0517	0.4009	0.1244	0.1664	-0.0484	0.0518	-0.1525	-0.0923	0.0579	-0.0431	0.0821	-0.1486	0.1193	0.0500	0.0361
ACW4	0.4897	0.8202	0.3555	0.5433	0.0038	0.3236	-0.2487	0.1282	0.3556	0.3296	0.3351	0.2392	0.4234	0.3817	0.1613
ACW5	0.4775	0.7035	0.2864	0.4250	0.0244	0.0114	-0.2562	-0.1081	0.1246	0.1276	0.3711	0.0494	0.2305	0.0757	0.3685
AR1	0.3136	0.2572	0.8528	0.1223	-0.0956	0.3196	-0.1725	0.1137	0.5475	0.5565	0.3462	0.1822	0.4067	0.3148	0.2428
AR2	0.2371	0.2790	0.8633	0.1806	-0.1549	0.4160	-0.1891	0.2479	0.6244	0.6495	0.3591	0.3708	0.4335	0.4024	0.2060
AR3	0.2605	0.1840	0.6358	0.1150	-0.2117	0.4153	-0.1841	0.2500	0.3502	0.3321	0.2346	0.2780	0.3180	0.4146	0.0823
OCS1	0.2671	0.4090	0.1210	0.6132	0.1474	0.0071	0.0833	0.1579	0.1128	0.0543	0.1664	0.1405	0.0355	-0.0013	0.0308
OCS2	0.2652	0.5979	0.1642	0.8794	-0.0005	0.1225	-0.1445	0.0641	0.2884	0.2288	0.1214	0.2111	0.2875	0.2030	0.1674
OCS3	0.3591	0.6281	0.1363	0.9538	0.0461	0.1674	-0.0625	0.1537	0.2849	0.2562	0.2180	0.2346	0.3171	0.1755	0.1377
OCS4	0.3484	0.6040	0.1739	0.9575	0.0244	0.1709	-0.1240	0.1304	0.3054	0.2570	0.2458	0.2006	0.3570	0.2129	0.1496
OCS5	0.3267	0.6084	0.1945	0.9310	-0.0099	0.1980	-0.1092	0.1275	0.2998	0.2636	0.2127	0.2497	0.3381	0.1847	0.1754
OCS6	0.3484	0.5646	0.1610	0.9161	-0.0049	0.1793	-0.0484	0.2221	0.2955	0.2671	0.2255	0.2580	0.3098	0.2235	0.1158
PA1	0.1226	0.1293	-0.1364	0.1009	0.7976	-0.1069	0.1672	0.1122	-0.1977	-0.1589	0.1832	-0.1150	0.0121	-0.0293	-0.0798
PA2	0.1040	0.0253	-0.1066	0.1015	0.7186	-0.0399	0.1689	0.1971	-0.1603	-0.1642	0.0543	-0.0237	0.0117	-0.0377	-0.1299
PA3	0.0220	0.0198	-0.1832	0.0021	0.8977	-0.1664	0.2731	0.1471	-0.2225	-0.2175	0.1220	-0.0969	-0.0994	-0.1021	-0.1986
PA4	0.0006	-0.0738	-0.1868	-0.0157	0.8910	-0.0843	0.3317	0.1836	-0.1956	-0.2218	0.0539	-0.0563	-0.0309	-0.0807	-0.2468
PA5	0.0025	-0.0096	-0.1650	0.0044	0.7812	-0.0774	0.2054	0.1089	-0.1662	-0.1748	0.0243	-0.0364	-0.0559	0.0238	-0.1939
PU1	0.1305	0.1608	0.4673	0.1316	-0.1081	0.9315	-0.2239	0.2301	0.5399	0.4034	0.2119	0.3819	0.5013	0.7772	-0.0538
PU2	0.1539	0.1950	0.4838	0.1522	-0.1438	0.9453	-0.2565	0.2372	0.5261	0.4077	0.2355	0.4136	0.5316	0.7972	-0.0537
PU3	0.1196	0.1346	0.4968	0.1179	-0.0993	0.9309	-0.3143	0.2198	0.5223	0.4122	0.1746	0.3881	0.5100	0.7753	-0.0374
PU4	0.1120	0.0998	0.4226	0.1129	-0.1069	0.9167	-0.1684	0.2536	0.5204	0.4277	0.1464	0.3984	0.4464	0.7196	-0.1037
PU5	0.0268	0.1664	0.3513	0.1303	-0.1160	0.8100	-0.1281	0.1791	0.4130	0.3489	0.2385	0.2525	0.3858	0.5989	-0.0420
PU6	0.1673	0.2011	0.4819	0.1662	-0.1101	0.9586	-0.2850	0.2543	0.5761	0.4728	0.2696	0.4253	0.5464	0.7944	-0.0318

	ACS	ACW	AR	OCS	PA	PU	RES	SA	SC	SU	UK	WPE	WPI	WPP	WPT
PU7	0.0601	0.1757	0.4086	0.2666	-0.0843	0.8935	-0.1794	0.1595	0.5189	0.4503	0.2121	0.3676	0.4649	0.7229	-0.0853
RES1	-0.2014	-0.1133	-0.0084	-0.0443	0.1773	-0.2822	0.5909	0.1029	-0.1325	-0.0916	-0.1568	0.0119	-0.1918	-0.2265	-0.2150
RES2	-0.0892	-0.1090	-0.0870	-0.0268	0.3608	-0.0768	0.7101	0.1971	-0.0812	-0.1627	-0.0479	-0.1177	-0.1292	-0.1459	-0.3013
RES3	-0.1848	-0.2527	-0.1742	-0.1268	0.2082	-0.1267	0.9060	0.2927	-0.0452	-0.0330	-0.0163	-0.0217	-0.1826	-0.2058	-0.3521
RES4	-0.1943	-0.2101	-0.1720	-0.0659	0.2075	-0.1575	0.8979	0.3008	-0.0193	-0.0079	-0.0149	0.0054	-0.2377	-0.2179	-0.3493
RES5	-0.1610	-0.2044	-0.1960	0.0042	0.2427	-0.1429	0.8331	0.2745	-0.0392	-0.0198	0.0578	0.0623	-0.1777	-0.1935	-0.3031
RES6	-0.1512	-0.2909	-0.1456	-0.0880	0.1977	-0.1311	0.8571	0.2534	-0.0653	-0.0863	0.0009	0.0995	-0.1215	-0.1489	-0.3566
RES7	-0.2488	-0.1882	-0.3912	-0.0971	0.1918	-0.4240	0.4509	-0.2103	-0.3769	-0.4425	-0.1685	-0.3329	-0.3472	-0.3914	-0.2092
SA1	0.2175	0.0847	0.3575	0.2216	0.1384	0.3110	0.1020	0.8591	0.3723	0.4466	0.3548	0.3562	0.2982	0.3448	-0.0340
SA2	0.1530	0.0533	0.2430	0.2334	0.1697	0.2666	0.1950	0.8935	0.3137	0.3658	0.3280	0.3923	0.3235	0.3210	-0.0888
SA3	0.0650	-0.0504	0.1556	0.0821	0.2635	0.1437	0.2503	0.8588	0.1568	0.1737	0.2434	0.4462	0.2048	0.2383	-0.1702
SA4	0.1491	-0.0132	0.1882	0.0766	0.1434	0.1442	0.2611	0.9024	0.2136	0.2530	0.3348	0.3967	0.2079	0.2522	-0.0852
SA5	0.2506	-0.0387	0.1871	0.0531	0.0457	0.1661	0.2050	0.7829	0.2432	0.2559	0.2208	0.3243	0.1402	0.2333	-0.0462
SC1	0.2790	0.3468	0.5268	0.3622	-0.2028	0.5001	-0.1629	0.1679	0.9026	0.7082	0.1919	0.3599	0.3471	0.4842	0.1724
SC2	0.1262	0.1886	0.5524	0.2634	-0.2270	0.5485	-0.0468	0.2580	0.8889	0.7393	0.2062	0.3068	0.2969	0.5040	0.0961
SC3	0.1306	0.1175	0.6627	0.1419	-0.1771	0.5108	-0.1028	0.3571	0.8518	0.7344	0.3423	0.3539	0.4044	0.5506	0.1374
SC4	0.1203	0.1562	0.5776	0.2018	-0.1810	0.4087	-0.1417	0.3509	0.7995	0.7885	0.2824	0.4166	0.3658	0.4352	0.1678
SU1	0.2588	0.1867	0.5940	0.2156	-0.1396	0.4054	-0.1504	0.3489	0.7495	0.9180	0.3465	0.4632	0.4442	0.4281	0.2453
SU2	0.3084	0.1781	0.6096	0.2118	-0.2262	0.4458	-0.1565	0.3533	0.7696	0.9162	0.3414	0.5009	0.3963	0.4542	0.2748
SU3	0.2248	0.1522	0.5676	0.2662	-0.2560	0.3776	-0.1099	0.2351	0.7580	0.8469	0.2266	0.3761	0.4065	0.4419	0.1784
UK1	0.5639	0.3307	0.3198	0.1711	0.1140	0.0722	-0.0187	0.1713	0.1241	0.1972	0.8914	0.1876	0.2652	0.2209	0.2791
UK2	0.5895	0.3637	0.3421	0.1546	0.1219	0.0845	-0.0401	0.1537	0.1538	0.2188	0.8834	0.2441	0.2509	0.2139	0.2895
UK3	0.4428	0.2476	0.3713	0.2398	0.0448	0.3641	-0.0774	0.4829	0.3740	0.4088	0.8445	0.3625	0.4308	0.5313	0.1467
WPE1	0.3657	0.1321	0.3293	0.2563	-0.0301	0.4215	-0.0560	0.3995	0.3930	0.4700	0.2938	0.8805	0.3896	0.5228	0.1041
WPE2	0.3725	0.1154	0.3651	0.2574	-0.0984	0.3563	-0.0820	0.3877	0.3828	0.4646	0.3214	0.9237	0.4069	0.4560	0.1071
WPE3	0.2087	0.0233	0.2842	0.1577	-0.0882	0.3468	-0.0127	0.4302	0.3480	0.4199	0.2573	0.9158	0.2900	0.4343	0.0546
WPI1	0.3169	0.2380	0.3732	0.1622	-0.0539	0.4186	-0.2629	0.2368	0.3015	0.3615	0.2828	0.4013	0.8231	0.5082	0.1485
WPI2	0.3839	0.3168	0.4671	0.3760	-0.0517	0.4652	-0.2127	0.2470	0.3549	0.4266	0.3215	0.3259	0.9267	0.4692	0.2060
WPI3	0.3792	0.2924	0.4054	0.3018	-0.0356	0.4351	-0.1881	0.2194	0.2795	0.3537	0.3105	0.3438	0.9184	0.4508	0.1975
WPI4	0.2942	0.3353	0.4814	0.3015	-0.0324	0.5431	-0.2574	0.2698	0.4555	0.4818	0.4190	0.3405	0.8617	0.6187	0.1318

	ACS	ACW	AR	OCS	PA	PU	RES	SA	SC	SU	UK	WPE	WPI	WPP	WPT
WPP1	0.2838	0.2524	0.4473	0.1863	-0.0270	0.7373	-0.2984	0.3088	0.5203	0.4439	0.3865	0.4868	0.5534	0.9451	0.0410
WPP2	0.2596	0.1844	0.4952	0.1182	-0.1016	0.7699	-0.2527	0.2968	0.5202	0.4968	0.2977	0.5244	0.5080	0.8920	0.0365
WPP3	0.2700	0.2379	0.4426	0.1857	-0.0726	0.7976	-0.2736	0.3058	0.5495	0.4793	0.4085	0.4791	0.5724	0.9743	0.0110
WPP4	0.2995	0.2616	0.4251	0.2560	-0.0386	0.7591	-0.2602	0.3086	0.5276	0.4405	0.4359	0.4688	0.5736	0.9501	0.0209
WPT1	0.3723	0.1893	0.0743	0.0880	-0.1253	-0.2451	-0.0447	-0.0939	0.0177	0.1192	0.2409	-0.0185	0.0274	-0.2138	0.6834
WPT2	0.3786	0.2174	0.1926	0.1200	-0.1458	-0.0854	-0.2909	-0.0437	0.1298	0.2055	0.2882	0.0416	0.1109	0.0449	0.8806
WPT3	0.2966	0.1210	0.1901	0.0725	-0.2550	-0.0410	-0.2306	-0.0532	0.1760	0.2458	0.2341	0.1066	0.0791	0.0318	0.8405
WPT4	0.4405	0.2806	0.2186	0.1758	-0.1913	0.0029	-0.4939	-0.1300	0.1626	0.2362	0.1614	0.1185	0.2739	0.0613	0.8666

Table 41: Revised Cross Loadings and Indicator Reliability

	ACS	ACW	AR	OCS	PA	PU	RES	SA	SC	UK	WPE	WPI	WPP	WPT
ACS1	0.9212	0.5159	0.2756	0.4366	0.0072	0.1114	-0.1889	0.1298	0.1970	0.5241	0.3120	0.3571	0.2464	0.4372
ACS2	0.9232	0.4549	0.2752	0.2575	0.0380	0.1415	-0.1440	0.2166	0.2155	0.5672	0.3391	0.3643	0.3067	0.4066
ACS3	0.9161	0.4533	0.2482	0.2166	0.0879	0.0874	-0.1621	0.1966	0.1608	0.5712	0.3130	0.3458	0.2757	0.3900
ACW1	0.2587	0.7397	0.1125	0.5168	-0.0461	0.0521	-0.1566	0.0204	0.1392	0.1778	0.0379	0.1579	0.1378	0.1906
ACW4	0.4899	0.8503	0.3485	0.5464	0.0008	0.3236	-0.2055	0.1281	0.3568	0.3346	0.2388	0.4231	0.3817	0.1576
ACW5	0.4785	0.7435	0.2654	0.4213	0.0225	0.0114	-0.2628	-0.1083	0.1255	0.3713	0.0493	0.2304	0.0757	0.3660
AR1	0.3137	0.2790	0.9086	0.1139	-0.0992	0.3196	-0.1433	0.1134	0.5433	0.3460	0.1819	0.4065	0.3148	0.2419
AR2	0.2372	0.3000	0.9446	0.1912	-0.1564	0.4160	-0.1285	0.2473	0.6206	0.3579	0.3708	0.4331	0.4024	0.2072
OCS2	0.2690	0.5991	0.1817	0.8944	-0.0035	0.1225	-0.1463	0.0636	0.2915	0.1212	0.2107	0.2872	0.2030	0.1649
OCS3	0.3625	0.6308	0.1377	0.9524	0.0423	0.1674	-0.0364	0.1530	0.2881	0.2180	0.2343	0.3167	0.1755	0.1360
OCS4	0.3521	0.5998	0.1722	0.9660	0.0213	0.1709	-0.0924	0.1298	0.3072	0.2459	0.2003	0.3565	0.2129	0.1485
OCS5	0.3305	0.5960	0.1753	0.9352	-0.0125	0.1980	-0.0831	0.1270	0.3019	0.2131	0.2493	0.3376	0.1847	0.1742
OCS6	0.3510	0.5521	0.1232	0.9174	-0.0084	0.1793	-0.0363	0.2220	0.2979	0.2252	0.2578	0.3094	0.2235	0.1148
PA1	0.1231	0.1251	-0.0653	0.0864	0.7843	-0.1069	0.1169	0.1115	-0.2002	0.1833	-0.1151	0.0119	-0.0293	-0.0796
PA2	0.1060	0.0469	-0.0502	0.0729	0.7036	-0.0399	0.1294	0.1966	-0.1613	0.0531	-0.0239	0.0118	-0.0377	-0.1314
PA3	0.0203	0.0129	-0.1334	-0.0181	0.8997	-0.1664	0.2504	0.1467	-0.2231	0.1221	-0.0968	-0.0992	-0.1022	-0.1996
PA4	-0.0003	-0.0975	-0.1396	-0.0294	0.8951	-0.0843	0.3209	0.1834	-0.1971	0.0544	-0.0564	-0.0310	-0.0807	-0.2478
PA5	0.0014	-0.0184	-0.1425	0.0064	0.7916	-0.0774	0.2152	0.1085	-0.1644	0.0247	-0.0365	-0.0562	0.0238	-0.1949
PU1	0.1299	0.1631	0.3870	0.1407	-0.1073	0.9315	-0.1323	0.2300	0.5404	0.2106	0.3817	0.5012	0.7773	-0.0548
PU2	0.1526	0.2075	0.3948	0.1621	-0.1436	0.9453	-0.1675	0.2370	0.5264	0.2347	0.4134	0.5314	0.7972	-0.0554
PU3	0.1194	0.1366	0.4219	0.1339	-0.0988	0.9309	-0.2238	0.2193	0.5217	0.1736	0.3878	0.5098	0.7754	-0.0391
PU4	0.1121	0.0979	0.3594	0.1265	-0.1060	0.9167	-0.0708	0.2532	0.5210	0.1456	0.3982	0.4462	0.7197	-0.1041
PU5	0.0250	0.1357	0.2565	0.1351	-0.1155	0.8100	-0.0540	0.1788	0.4137	0.2380	0.2525	0.3856	0.5989	-0.0420
PU6	0.1666	0.1974	0.4010	0.1764	-0.1099	0.9586	-0.1815	0.2539	0.5762	0.2683	0.4251	0.5461	0.7944	-0.0330
PU7	0.0613	0.1846	0.3292	0.2768	-0.0872	0.8935	-0.0937	0.1589	0.5195	0.2109	0.3674	0.4646	0.7230	-0.0860
RES2	-0.0883	-0.1335	-0.0593	-0.0423	0.3610	-0.0768	0.7012	0.1972	-0.0784	-0.0468	-0.1181	-0.1292	-0.1459	-0.3008
RES3	-0.1859	-0.2642	-0.1529	-0.1360	0.2114	-0.1267	0.9359	0.2932	-0.0438	-0.0161	-0.0217	-0.1827	-0.2058	-0.3487

	ACS	ACW	AR	OCS	PA	PU	RES	SA	SC	UK	WPE	WPI	WPP	WPT
RES4	-0.1952	-0.2280	-0.1576	-0.0801	0.2122	-0.1575	0.9344	0.3011	-0.0178	-0.0147	0.0054	-0.2379	-0.2179	-0.3453
RES5	-0.1617	-0.2206	-0.1446	-0.0053	0.2459	-0.1429	0.8644	0.2745	-0.0398	0.0579	0.0626	-0.1780	-0.1935	-0.2976
RES6	-0.1532	-0.2906	-0.1025	-0.0940	0.2048	-0.1311	0.8844	0.2536	-0.0641	0.0014	0.0997	-0.1216	-0.1488	-0.3534
SA1	0.2173	0.0960	0.3007	0.2145	0.1338	0.3110	0.1778	0.8584	0.3697	0.3540	0.3560	0.2977	0.3448	-0.0341
SA2	0.1524	0.0689	0.2010	0.2193	0.1701	0.2666	0.2581	0.8926	0.3111	0.3271	0.3925	0.3233	0.3210	-0.0883
SA3	0.0628	-0.0314	0.1421	0.0713	0.2630	0.1437	0.2975	0.8584	0.1530	0.2427	0.4463	0.2050	0.2382	-0.1689
SA4	0.1458	0.0076	0.1301	0.0706	0.1442	0.1442	0.3241	0.9032	0.2111	0.3342	0.3970	0.2080	0.2522	-0.0837
SA5	0.2498	-0.0401	0.0880	0.0502	0.0467	0.1661	0.2613	0.7845	0.2439	0.2203	0.3242	0.1403	0.2333	-0.0454
SC1	0.2794	0.3484	0.4949	0.3656	-0.2021	0.5001	-0.0936	0.1677	0.9036	0.1913	0.3597	0.3468	0.4842	0.1710
SC2	0.1256	0.1829	0.5144	0.2734	-0.2240	0.5485	0.0322	0.2582	0.8946	0.2050	0.3065	0.2967	0.5040	0.0959
SC3	0.1298	0.1436	0.6779	0.1403	-0.1781	0.5108	-0.0293	0.3568	0.8443	0.3408	0.3539	0.4039	0.5506	0.1385
SC4	0.1200	0.1786	0.5956	0.2190	-0.1820	0.4087	-0.0726	0.3504	0.7964	0.2812	0.4166	0.3654	0.4352	0.1698
UK1	0.5630	0.3421	0.2921	0.1684	0.1131	0.0722	0.0236	0.1713	0.1220	0.8937	0.1872	0.2650	0.2209	0.2799
UK2	0.5894	0.3859	0.3359	0.1456	0.1195	0.0845	-0.0018	0.1536	0.1515	0.8833	0.2438	0.2508	0.2139	0.2910
UK3	0.4419	0.2790	0.3534	0.2361	0.0394	0.3641	-0.0213	0.4828	0.3702	0.8430	0.3626	0.4304	0.5313	0.1476
WPE1	0.3668	0.1520	0.2829	0.2598	-0.0302	0.4215	0.0214	0.3993	0.3934	0.2931	0.8797	0.3897	0.5228	0.1036
WPE2	0.3717	0.1584	0.3038	0.2542	-0.0964	0.3563	-0.0227	0.3876	0.3813	0.3203	0.9236	0.4073	0.4560	0.1060
WPE3	0.2072	0.0874	0.2561	0.1566	-0.0863	0.3468	0.0282	0.4301	0.3449	0.2557	0.9166	0.2902	0.4344	0.0555
WPI1	0.3158	0.2615	0.3129	0.1794	-0.0563	0.4186	-0.2261	0.2366	0.3009	0.2823	0.4010	0.8243	0.5082	0.1454
WPI2	0.3848	0.3298	0.4339	0.3955	-0.0554	0.4652	-0.1495	0.2467	0.3526	0.3216	0.3254	0.9265	0.4692	0.2034
WPI3	0.3794	0.3034	0.3697	0.3165	-0.0384	0.4351	-0.1364	0.2190	0.2770	0.3104	0.3435	0.9184	0.4508	0.1946
WPI4	0.2939	0.3446	0.4684	0.3210	-0.0321	0.5431	-0.1837	0.2691	0.4514	0.4180	0.3403	0.8608	0.6186	0.1298
WPP1	0.2830	0.2578	0.3375	0.2011	-0.0262	0.7373	-0.2300	0.3085	0.5187	0.3858	0.4865	0.5534	0.9451	0.0392
WPP2	0.2580	0.2136	0.4148	0.1282	-0.1009	0.7699	-0.1806	0.2970	0.5190	0.2968	0.5242	0.5078	0.8922	0.0366
WPP3	0.2690	0.2501	0.3622	0.2028	-0.0724	0.7976	-0.1986	0.3055	0.5485	0.4076	0.4789	0.5723	0.9743	0.0098
WPP4	0.2988	0.2773	0.3596	0.2722	-0.0387	0.7591	-0.1887	0.3082	0.5256	0.4348	0.4686	0.5734	0.9500	0.0198
WPT1	0.3724	0.2209	0.1306	0.0894	-0.1293	-0.2451	-0.0417	-0.0934	0.0175	0.2410	-0.0185	0.0273	-0.2138	0.6868
WPT2	0.3793	0.2342	0.2016	0.1293	-0.1479	-0.0854	-0.2786	-0.0433	0.1294	0.2887	0.0414	0.1108	0.0449	0.8830
WPT3	0.2975	0.1494	0.2244	0.0772	-0.2589	-0.0410	-0.2314	-0.0530	0.1735	0.2338	0.1067	0.0790	0.0319	0.8478
WPT4	0.4410	0.3338	0.2071	0.1831	-0.1944	0.0029	-0.4712	-0.1301	0.1622	0.1617	0.1182	0.2740	0.0613	0.8599

Table 42: Inter-Construct Correlations

	ACS	ACW	AR	OCS	PA	PU	RES	SA	SC	UK	WPE	WPI	WPP	WPT
ACS	0.9202													
ACW	0.5241	0.7795												
AR	0.2916	0.3131	0.9268											
OCS	0.3575	0.6381	0.1692	0.9334										
PA	0.0398	-0.0106	-0.1414	0.0087	0.8182									
PU	0.1236	0.1768	0.4022	0.1802	-0.1200	0.9135								
RES	-0.1838	-0.2646	-0.1454	-0.0838	0.2782	-0.1483	0.7540							
SA	0.1866	0.0260	0.2029	0.1494	0.1818	0.2407	0.3066	0.7403						
SC	0.2096	0.2738	0.6316	0.3184	-0.2301	0.5683	-0.0540	0.2987	0.7411					
UK	0.5959	0.3757	0.3797	0.2205	0.0956	0.2311	-0.0028	0.3457	0.2721	0.7632				
WPE	0.3495	0.1469	0.3102	0.2479	-0.0774	0.4147	0.0100	0.4474	0.4124	0.3199	0.9068			
WPI	0.3878	0.3538	0.4545	0.3484	-0.0510	0.5316	-0.1961	0.2765	0.3975	0.3818	0.3984	0.7810		
WPP	0.2946	0.2656	0.3916	0.2142	-0.0633	0.8145	-0.2120	0.3240	0.5614	0.4058	0.5208	0.5838	0.9409	
WPT	0.4544	0.2982	0.2384	0.1581	-0.2257	-0.0695	-0.3742	-0.1011	0.1659	0.2616	0.0955	0.1878	0.0220	0.8247

To assess discriminant validity, measures should load more highly on their own constructs than on any other constructs in the model, by a magnitude of 10 (Chin & Newsted, 1999; Haenlein & Kaplan, 2004). This means that the loadings should be higher than cross-loadings. These loadings and cross-loadings are reflected in Table 40.

The factor analysis conducted during the pilot study reflected that SC, SU and AR loaded onto a single construct. The main study corroborated that the SC and SU indicators cross-loaded equally highly on each other as on their own constructs, requiring one of these constructs to be removed. It was decided to remove the Shared Understanding construct as it was not part of Szulanski's original framework of knowledge transfer barriers. After SU was dropped from the model, SC and AR presented as separate and distinct constructs.

Although the Perceived Usefulness and Compatibility with Preferred Practices indicators cross-loaded highly on each other, a magnitude of 10 difference is still reflected between the loadings. Consequently, Perceived Usefulness and Compatibility with Preferred Practices were able to be retained as distinct and separate constructs for the structural model assessment phase of the analysis. This issue is discussed further in Section 10.2.2.

After deleting the Shared Understanding construct, as well as the other problems identified above with the convergent validity of the scales, all remaining indicators loaded more highly on their own construct than on other constructs, indicating adequate discriminant validity of the model. This is reflected in Table 41.

Discriminant validity can also be demonstrated when the variance shared between a construct and any other construct is less than the variance than that construct shares with its indicators (Fornell, Tellis, & Zinkhan, 1982). This is assessed by calculating the square root of the average variance extracted (AVE) for a given construct, and comparing it with the correlations between that construct and all other constructs. As reflected in Table 42, each of the square roots of the AVEs of each construct is greater than the off-diagonal elements in the corresponding rows and columns; thus demonstrating that the construct is more strongly correlated with its indicators than with the other constructs in the model.

Having established that the measures sufficiently represent the constructs being tested through internal consistency, convergent and discriminant validity of the measurement model, attention can now be turned to the examination of the structural relationships between the constructs.

9.4.2. The Structural Model

The primary evaluation criteria for the structural model are the R^2 values and the level and significance of the path coefficients (Hair et al., 2011). Table 43 reflects the R^2 values of the endogenous variables of the model.

Table 43: R^2 Values

	R Square
ACS	0.127767
ACW	0.407479
AR	0.028645
PU	0.679188
RES	0.247097
SC	0.101378
UK	0.04852
WPE	0.23621
WPI	0.166699
WPP	0.214302
WPT	0.160714

Because the primary goal of PLS-SEM is to explain the variance in endogenous latent variables, the key target constructs' R^2 value should be high (Hair et al., 2011). As a rule of thumb, R^2 values of 0.75, 0.50 and 0.25 for endogenous latent variables in the structural model can be described as substantial, moderate, and weak, respectively. As reflected in Table 43:

- 68% of the variance in the key target PU variable is explained – a substantial amount
- 41% of the variance in the ACW variable is explained – a moderate amount, but not a key target variable

- 25% of the variance in the RES variable, 24% of variance in WPE, and 21% of the variance in WPP are explained – weak amounts. WPE and WPP are key target variables, but not RES.

The other two key target variables of WPT and WPI reflect insignificant R^2 values of less than 0.25. Given that four out of the five key target variables reflect weak or insignificant R^2 values, it was deemed necessary to consider an alternative model.

The model was extended to test the direct effects of the barriers on the dimensions of Work Practice Compatibility in an attempt to increase the R^2 values of those key target variables. A top-level diagram of the extended research model is reflected in Figure 23, whilst Figures 24 - 26 reflect the following additional hypotheses that were incorporated into the model and tested:

H3-5	Increased Absorptive Capacity of System Knowledge will decrease perceptions of Compatibility with Existing Practices
H3-6	Increased Absorptive Capacity of System Knowledge will decrease perceptions of Compatibility with Imposed Practices
H3-7	Increased Absorptive Capacity of System Knowledge will decrease perceptions of Compatibility with Preferred Practices
H3-8	Increased Absorptive Capacity of System Knowledge will decrease perceptions of Compatibility with Past Experiences with Technology
H3-9	Increased Absorptive Capacity of Work Domain Knowledge will decrease perceptions of Compatibility with Existing Practices.
H3-10	Increased Absorptive Capacity of Work Domain Knowledge will decrease perceptions of Compatibility with Imposed Practices.

H3-11 Increased Absorptive Capacity of Work Domain Knowledge will decrease perceptions of Compatibility with Preferred Practices,

H3-12 Increased Absorptive Capacity of Work Domain Knowledge will decrease perceptions of Compatibility with Past Experiences with Technology

H3-13 Increased arduousness of relationships will decrease perceptions of Compatibility with Existing Practices

H3-14 Increased arduousness of relationships will decrease perceptions of Compatibility with Imposed Practices,

H3-15 Increased arduousness of relationships will decrease perceptions of Compatibility with Preferred Practices.

H3-16 Increased arduousness of relationships will decrease perceptions of Compatibility with Past Experiences with Technology.

H3-17 Increased perceptions of Source Credibility will increase perceptions of Compatibility with Existing Practices.

H3-18 Increased perceptions of Source Credibility will increase perceptions of Compatibility with Imposed Practices.

H3-19 Increased perceptions of Source Credibility will increase perceptions of Compatibility with Preferred Practices.

H3-20 Increased perceptions of Source Credibility will increase perceptions of Compatibility with Past Experiences with Technology.

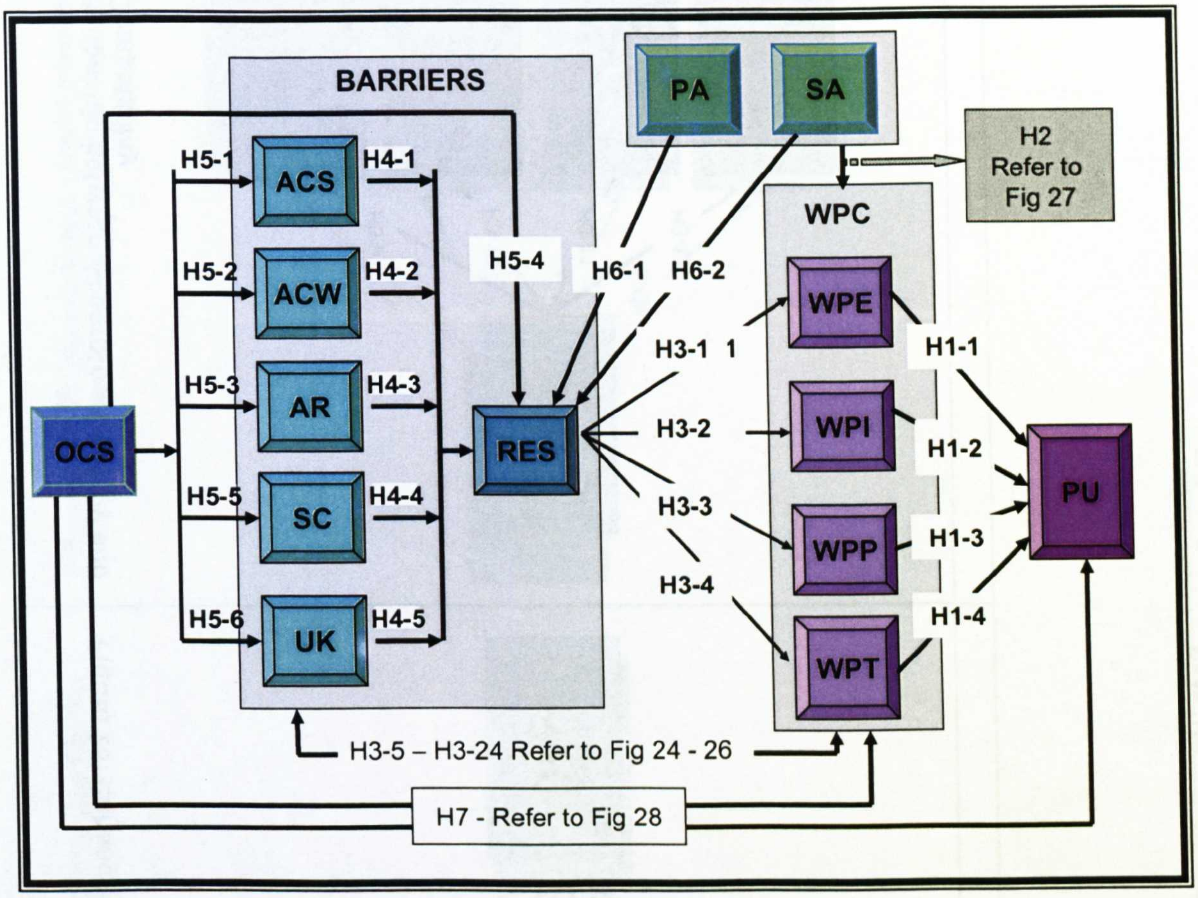
H3-21 Increased perceptions of Unproven Knowledge will decrease perceptions of Compatibility with Existing Practices.

H3-22 Increased perceptions of Unproven Knowledge will decrease perceptions of Compatibility with Imposed Practices.

H3-23 Increased perceptions of Unproven Knowledge will decrease perceptions of Compatibility with Preferred Practices.

H3-24 Increased perceptions of Unproven Knowledge will decrease perceptions of Compatibility with Past Experiences with Technology.

Figure 23: Enhanced Research Model



After incorporating the additional hypotheses into the model, the largest number of structural paths directed at any construct amounts to 9. Thus, a minimum of 90 observations is required for a PLS-SEM analysis (Haenlein & Kaplan, 2004; Hai et al., 2011), which does not affect the adequacy of the sample size obtained for this study.

Figure 24: Enhanced Model – Relationship between Absorptive Capacity and Compatibility

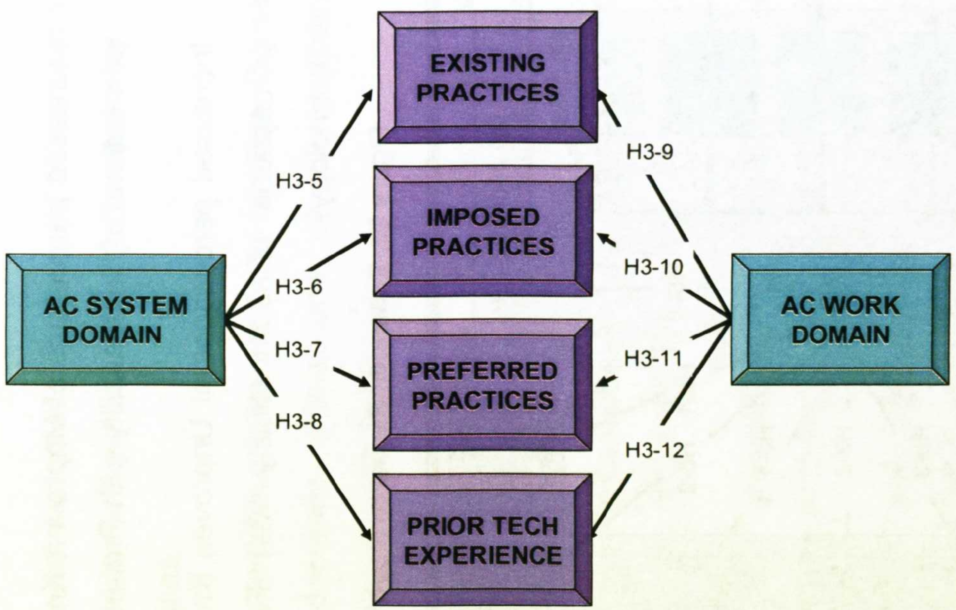


Figure 25: Enhanced Model – Relationship between Arduous Relationship, Resistance and Compatibility

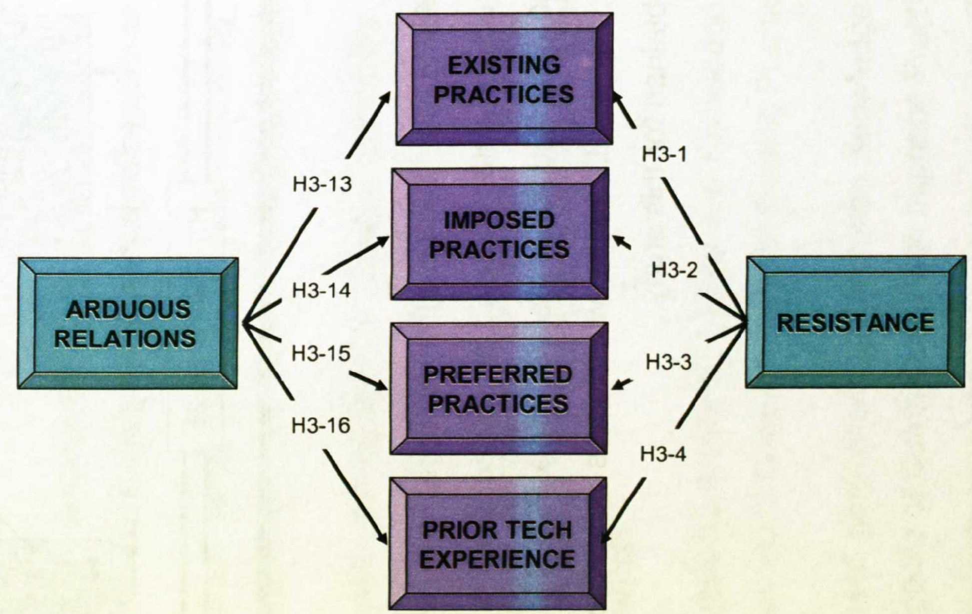


Figure 26: Enhanced Model - Relationship between Source Credibility, Unproven Knowledge and Compatibility

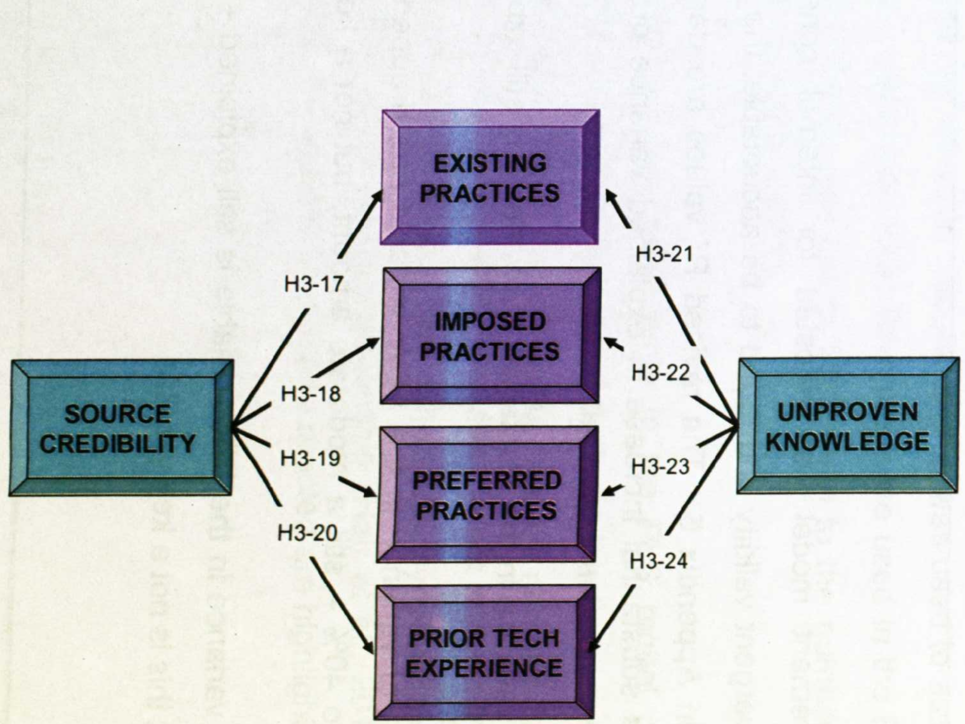


Figure 27: Enhanced Model - Relationship between System and Process Adaptation and Compatibility

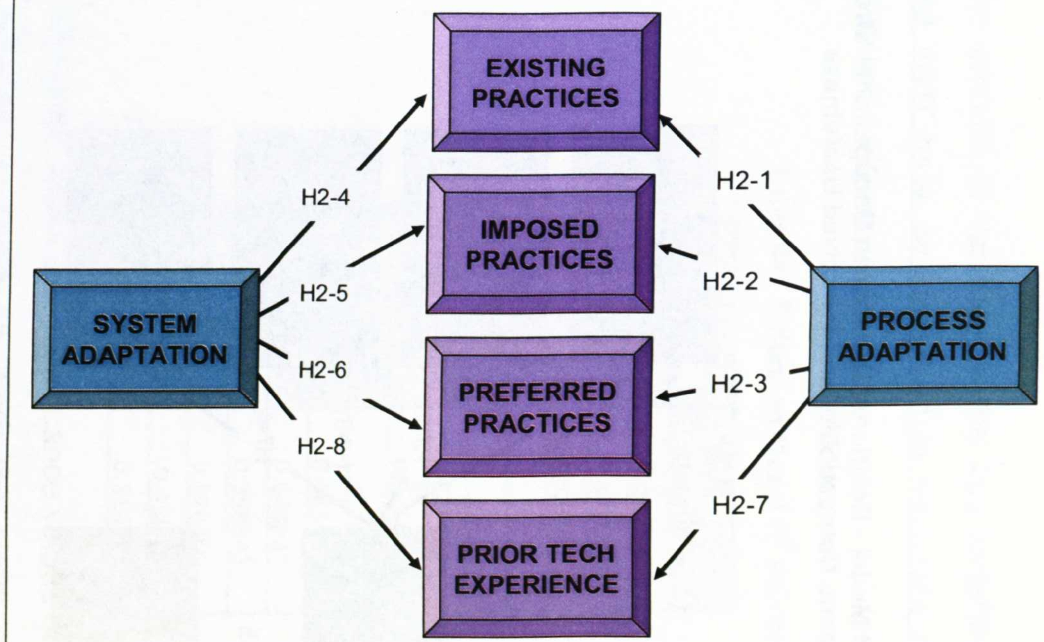
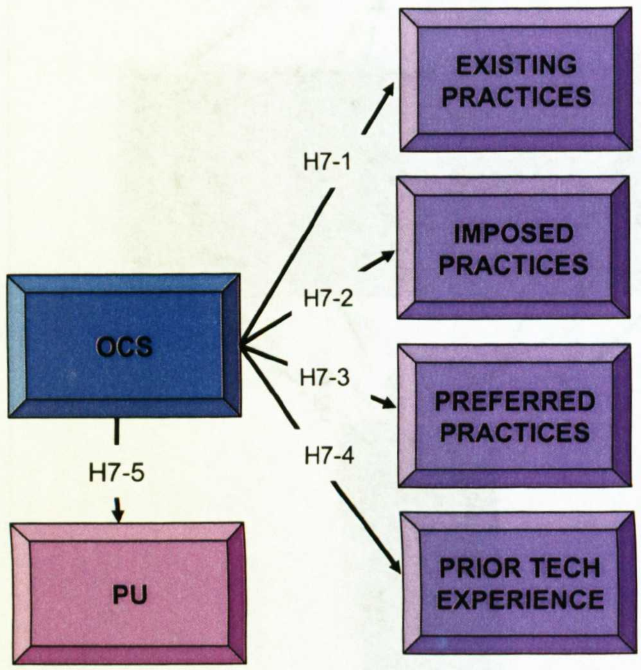


Figure 28: Enhanced Model - Relationship between Occupational Strength of Commitment, Compatibility and Perceived Usefulness



The revised measurement model was retested for internal consistency, discriminant and convergent validity and found to be acceptable; the detailed results are included in Appendix 5. The revised R^2 values are depicted in Table 44, reflecting a substantial increase in explained variance of the key variables:

- 68% of the variance in the key target PU variable is still explained – a substantial amount
- The amount of variance in the ACW variable has dropped slightly from 41% to 40% – still a moderate amount, but not a key target variable
- 25% of the variance in the RES variable is still explained – a weak amount, but this is not a key variable

- The amount of variance in the key variables of WPE, WPI, WPP and WPT have all increased to moderate amounts of 36%, 37%, 46% and 31% respectively.

Table 44: Extended Model R^2 Values

	R Square
ACS	0.11222
ACW	0.402512
AR	0.028392
OCS	
PA	
PU	0.679677
RES	0.246434
SA	
SC	0.083581
UK	0.048841
WPE	0.358843
WPI	0.370266
WPP	0.45697
WPT	0.314281

The path coefficients, t-stats and significance values of the extended structural model are reflected in Table 45. Both the direct and total effects of the constructs are reflected. Bootstrapping was used to assess the significance of the path coefficients. 5000 Samples were used in the Bootstrap test, and the number of cases was set to 110, equal to the number of valid cases in the dataset (Hair et al., 2011).

The individual path coefficients in the PLS model can be interpreted as standardized beta coefficients of ordinary least squares regression (Henseler et al., 2009, p.304). Structural paths, that are non significant or that show signs opposite to the hypothesized direction, do not support the hypothesis, whereas paths that are significant and reflect the hypothesized direction empirically support the hypothesized relationship (Hair et al., 2011, p.147). Paths that show signs contradictory to those expected are highlighted in green.

Table 45: Model Fit Statistics

	Hypothesis	Direct Effects				Total Effects			
		Path Coeff	t-Stat	Sig	R2	Path Coeff	t-Stat	Sig	R2
	Effect of OCS on Barriers								
H5-1	OCS --> ACS = +ve	0.3350	23.5538	p < 0.001	11.22	0.3350	23.5538	p < 0.001	11.22
H5-2	OCS --> ACW = +ve	0.6344	32.5841	p < 0.001	40.25	0.6344	32.5841	p < 0.001	40.25
H5-3	OCS --> AR = -ve	0.1685	10.2699	p < 0.001	2.84	0.1685	10.2699	p < 0.001	2.84
H5-4	OCS --> RES = +ve	0.0667	5.9799	p < 0.001	0.44	**-0.1276**	12.6508	p < 0.001	1.63
H5-5	OCS --> SC = -ve	0.2891	18.9963	p < 0.001	8.36	0.2891	18.9963	p < 0.001	8.36
H5-6	OCS --> UK = -ve	0.2210	18.9785	p < 0.001	4.88	0.2210	18.9785	p < 0.001	4.88
	Effects of Adaptation on Resistance								
H6-1	PA --> RES = +ve	0.2156	12.0190	p < 0.001	4.65	0.2156	12.0190	p < 0.001	4.65
H6-2	SA --> RES = -ve	0.2809	19.6422	p < 0.001	7.89	0.2809	19.6422	p < 0.001	7.89
	Effects of other Barriers on Resistance								
H4-1	ACS --> RES = +ve	-0.1707	13.3725	p < 0.001	2.91	-0.1707	13.3725	p < 0.001	2.91
H4-2	ACW --> RES = +ve	-0.2293	14.6957	p < 0.001	5.26	-0.2293	14.6957	p < 0.001	5.26
H4-3	AR --> RES = -ve	-0.1102	8.2846	p < 0.001	1.21	-0.1102	8.2846	p < 0.001	1.21
H4-4	SC --> RES = -ve	0.0270	1.8680	p < 0.10	0.07	0.0270	1.8680	p < 0.10	0.07
H4-5	UK --> RES = -ve	0.0866	6.3702	p < 0.001	0.75	0.0866	6.3702	p < 0.001	0.75
	Effects of Barriers on Work Practice Compatibility								
H3-1	RES --> WPE = -ve	-0.0336	2.6900	p < 0.01	0.11	-0.0336	2.6900	p < 0.01	0.11
H3-2	RES --> WPI = -ve	-0.1728	16.7975	p < 0.001	2.98	-0.1728	16.7975	p < 0.001	2.98
H3-3	RES --> WPP = -ve	-0.2619	25.3383	p < 0.001	6.86	-0.2619	25.3383	p < 0.001	6.86

	Hypothesis	Direct Effects				Total Effects			
		Path Coeff	t-Stat	Sig	R2	Path Coeff	t-Stat	Sig	R2
H3-4	RES --> WPT = -ve	-0.1636	10.6875	p < 0.001	2.68	-0.1636	10.6875	p < 0.001	2.68
H3-5	ACS --> WPE = -ve	0.2672	14.9928	p < 0.001	7.1381	0.2729	14.7351	p < 0.001	7.45
H3-6	ACS --> WPI = -ve	0.1165	8.8867	p < 0.001	1.3564	0.1460	11.5914	p < 0.001	2.13
H3-7	ACS --> WPP = -ve	0.0108	0.9060	non sig	0.0117	0.0555	4.6230	p < 0.001	0.31
H3-8	ACS --> WPT = -ve	0.3947	23.1006	p < 0.001	15.5783	0.4226	22.9509	p < 0.001	17.86
H3-9	ACW--> WPE = -ve	-0.1638	9.1381	p < 0.001	2.6828	-0.1561	8.9136	p < 0.001	2.44
H3-10	ACW--> WPI = -ve	0.0013	0.0843	non sig	0.0002	0.0409	2.7052	p < 0.01	0.17
H3-11	ACW--> WPP = -ve	0.0444	3.3261	p < 0.01	0.1970	0.1045	7.5235	p < 0.001	1.09
H3-12	ACW--> WPT = -ve	-0.0215	1.0258	non sig	0.0463	**0.0160**	0.7982	non sig	0.03
H3-13	AR--> WPE = +ve	0.0308	1.9142	p < 0.10	0.0946	0.0345	2.1163	p < 0.05	0.12
H3-14	AR--> WPI = +ve	0.2385	13.3024	p < 0.001	5.6888	0.2575	13.9421	p < 0.001	6.63
H3-15	AR--> WPP = +ve	-0.1112	5.3810	p < 0.001	1.2376	-0.0824	3.9625	p < 0.001	0.68
H3-16	AR--> WPT = +ve	0.0707	4.5906	p < 0.001	0.4992	0.0887	5.6912	p < 0.001	0.79
H3-17	SC --> WPE = +ve	0.2142	10.6849	p < 0.001	4.5885	0.2133	10.5826	p < 0.001	4.55
H3-18	SC--> WPI = +ve	0.0841	4.6234	p < 0.001	0.7068	0.0794	4.1105	p < 0.001	0.63
H3-19	SC--> WPP = +ve	0.5240	28.7930	p < 0.001	27.4557	0.5169	29.2345	p < 0.001	26.72
H3-20	SC--> WPT = +ve	0.0069	0.3895	non sig	0.0047	0.0024	0.1319	non sig	0.00
H3-21	UK--> WPE = +ve	0.0149	0.8843	non sig	0.0223	0.0120	0.6982	non sig	0.01
H3-22	UK--> WPI = +ve	0.0972	6.8745	p < 0.001	0.9438	0.0822	5.7180	p < 0.001	0.68
H3-23	UK --> WPP = +ve	0.2153	15.1516	p < 0.001	4.6359	0.1926	12.5276	p < 0.001	3.71
H3-24	UK --> WPT = +ve	0.0765	4.5868	p < 0.001	0.5857	0.0624	3.7899	p < 0.001	0.39

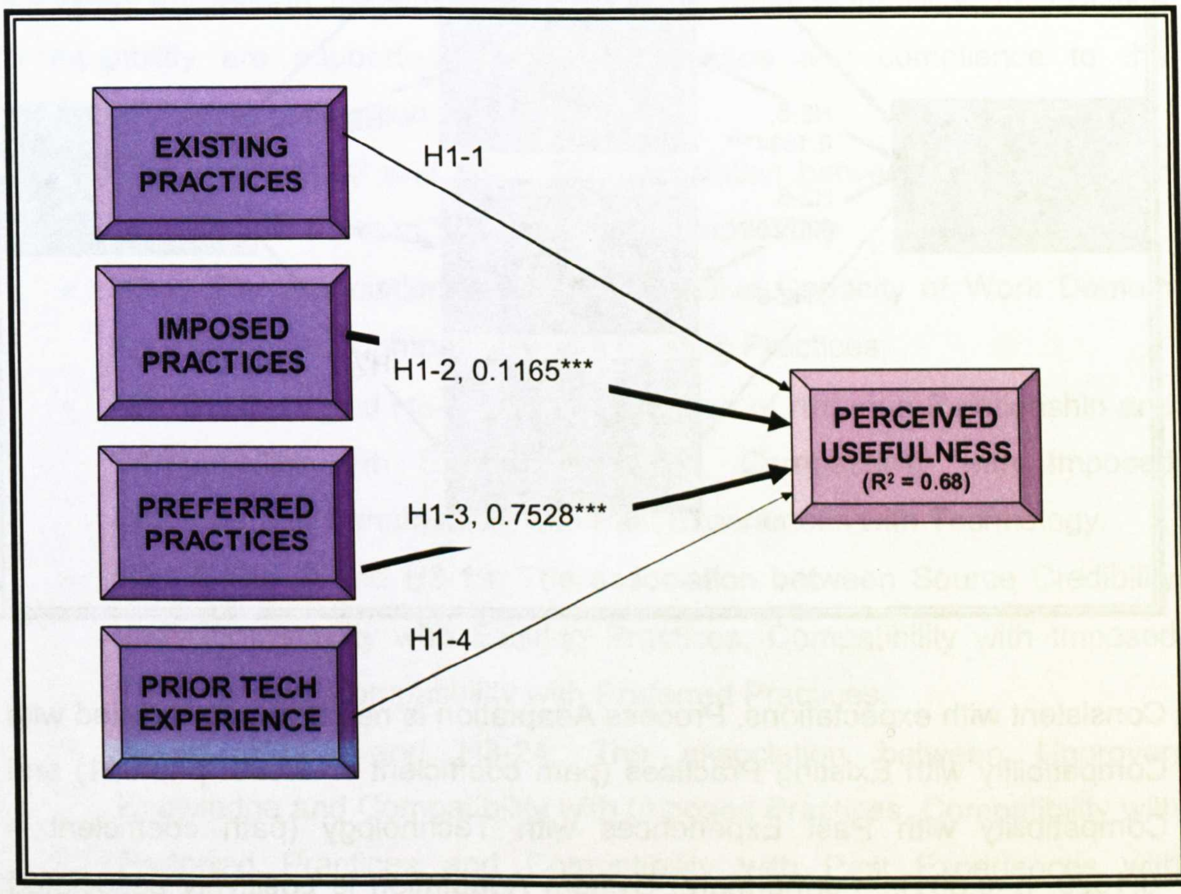
	Hypothesis	Direct Effects				Total Effects			
		Path Coeff	t-Stat	Sig	R2	Path Coeff	t-Stat	Sig	R2
	Effects of Process Adaptation on Work Practice Compatibility								
H2-1	**PA --> WPE = -ve**	-0.0896	5.0928	p < 0.001	0.80	-0.0969	5.6377	p < 0.001	0.94
H2-2	**PA --> WPI = -ve**	0.0033	0.2982	non sig	0.00	**-0.0340**	3.1916	p < 0.01	0.12
H2-3	**PA --> WPP = -ve**	0.0619	6.5609	p < 0.001	0.38	0.0054	0.4930	non sig	0.00
H2-7	**PA --> WPT = -ve**	-0.1629	12.6603	p < 0.001	2.65	-0.1981	15.7517	p < 0.001	3.93
	Effects of System Adaptation on Work Practice Compatibility								
H2-4	**SA --> WPE = +ve**	0.3236	19.7439	p < 0.001	10.47	0.3142	18.8851	p < 0.001	9.87
H2-5	**SA --> WPI = +ve**	0.1694	16.1221	p < 0.001	2.87	0.1209	11.9831	p < 0.001	1.46
H2-6	**SA --> WPP = +ve**	0.1725	12.4467	p < 0.001	2.98	0.0990	6.5592	p < 0.001	0.98
H2-8	**SA --> WPT = +ve**	-0.1405	10.7650	p < 0.001	1.97	-0.1865	14.3833	p < 0.001	3.48
	Effects of Work Practice Compatibility on Perceived Usefulness								
H1-1	**WPE --> PU = +ve**	-0.0144	1.4466	non sig	0.02	-0.0144	1.4466	non sig	0.02
H1-2	**WPI --> PU = +ve**	0.1165	9.9713	p < 0.001	1.36	0.1165	9.9713	p < 0.001	1.36
H1-3	**WPP --> PU = +ve**	0.7528	58.9278	p < 0.001	56.67	0.7528	58.9278	p < 0.001	56.67
H1-4	**WPT --> PU = +ve**	-0.1090	11.7653	p < 0.001	1.19	-0.1090	11.7653	p < 0.001	1.19
	Effects of OCS on Work Practice Compatibility and Perceived Usefulness								
H7-1	**OCS --> WPE = -ve**	0.1433	7.7367	p < 0.001	2.05	**-0.2029**	15.2890	p < 0.001	4.15
H7-2	**OCS --> WPI = -ve**	0.1835	12.3179	p < 0.001	3.37	**-0.3313**	22.2857	p < 0.001	10.98
H7-3	**OCS --> WPP = -ve**	-0.0459	3.1161	p < 0.01	0.21	-0.2007	16.1498	p < 0.001	3.99
H7-4	**OCS --> WPT = -ve**	0.0096	0.7673	non sig	0.01	**-0.1814**	13.3603	p < 0.001	3.23
H7-5	**OCS --> PU = -ve**	-0.0020	0.1777	non sig	0.00	**0.1644**	10.2626	p < 0.001	2.70

9.4.2.1. Direct Effects of Work Practice Compatibility on Perceived Usefulness

The results of the PLS analysis for this set of variable relationships are reflected in Figure 29. Supported hypotheses are depicted with a bold line and reflect the path coefficient and significance level.

As hypothesized, Perceived Usefulness is significantly associated with Compatibility with Preferred Practices (path coefficient = 0.7528, p<0.001) and Compatibility with Imposed Practices (path coefficient = 0.1165, p<1.001). Both paths have effects in the direction hypothesized, and therefore Hypotheses H1-2 and H1-3 are supported.

Figure 29: PLS Results - Relationship between Compatibility and Perceived Usefulness

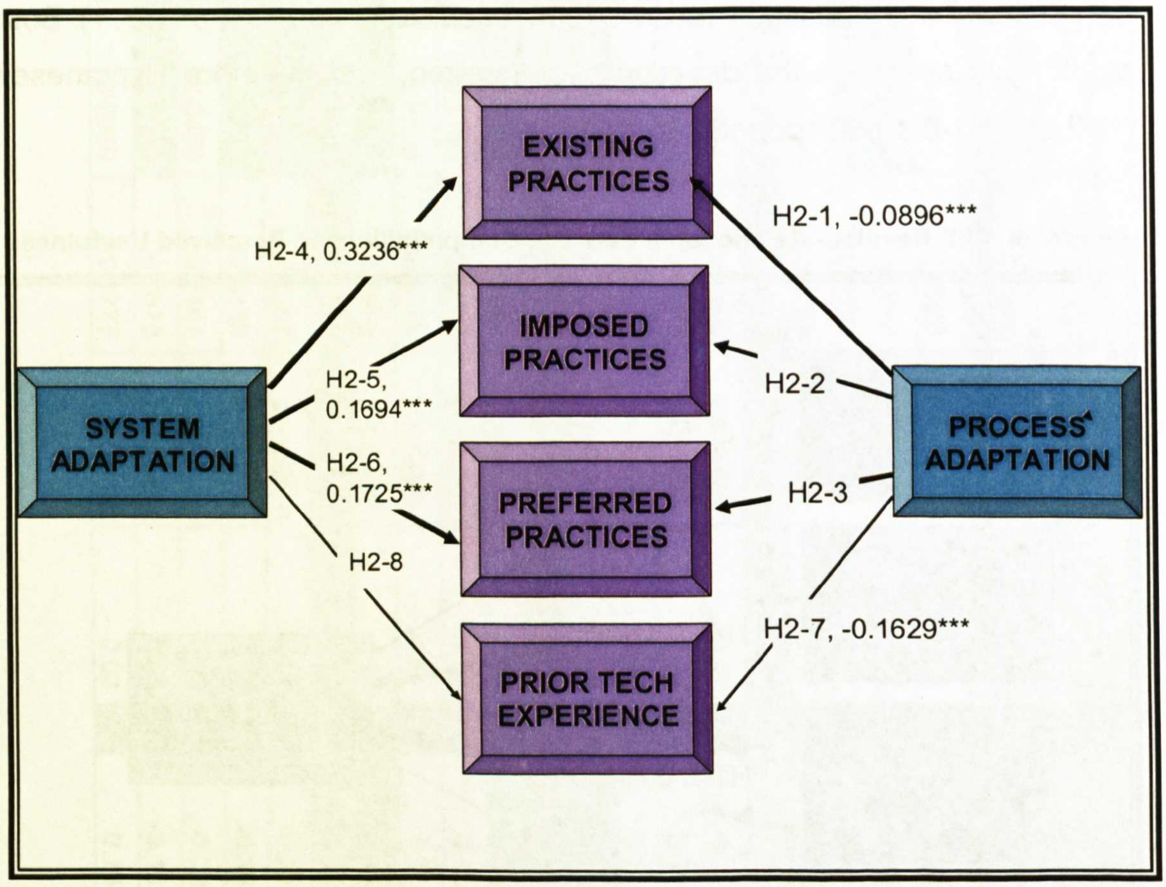


Contrary to expectations, Compatibility with Existing Practices has no significant effect on Perceived Usefulness. In addition, Compatibility with Past Experiences with Technology, although reflecting a significant effect on the dependent variable, has a path coefficient that in the opposite direction to that hypothesized. Thus, Hypotheses H1-1 and H1-4 are not supported.

9.4.2.2. Direct Effects of Adaptation on Work Practice Compatibility

The results of the PLS analysis are graphically depicted for these two sets of relationships in Figure 30.

Figure 30: PLS Results - Relationship between Adaptation and Compatibility



Consistent with expectations, Process Adaptation is negatively associated with Compatibility with Existing Practices (path coefficient = -0.089. p<0.001) and Compatibility with Past Experiences with Technology (path coefficient = -0.1629, p<0.001). Furthermore, System Adaptation is positively associated with Compatibility with Existing Practices (path coefficient = 0.32, p<0.001), Compatibility with Imposed Practices (path coefficient = 0.169, p<0.001) and Compatibility with Preferred Practices (path coefficient = 0.172, p<0.001). All these paths have effects in the direction hypothesized, and therefore Hypotheses 2-1, H2-7, H2-4, H2-5 and H2-6 are supported.

In contrast to expectations, Process Adaptation has no significant effect on Compatibility with Imposed Practices. In addition, although reflecting significant effects, the path coefficients between (1) Process Adaptation and Compatibility with Preferred Practices, and (2) System Adaptation and Compatibility with Past Experiences with Technology both have effects opposite to the hypothesized direction. As a result, H2-2, H2-3 and H2-8 are not supported

9.4.2.3. Direct Effects of Barriers on Work Practice Compatibility

The results of the PLS analysis are graphically depicted for these sets of relationships in Figures 31 – 33. Fourteen of the 24 hypothesized relationships between Knowledge transfer barriers and the dimensions of Work Practice Compatibility are supported due to significance and compliance to the hypothesized effect direction, namely:

- H3-1, H3-2, H3-3 and H3-4: The association between Resistance and all four dimensions of Work Practice Compatibility
- H3-9: The association between Absorptive Capacity of Work Domain Knowledge and Compatibility with Existing Practices
- H3-13, H3-14 and H3-16: The association of Arduous Relationship and Compatibility with Existing Practices, Compatibility with Imposed Practices and Compatibility with Past Experiences with Technology.
- H3-17, H3-18 and H3-19: The association between Source Credibility and Compatibility with Existing Practices, Compatibility with Imposed Practices and Compatibility with Preferred Practices.
- H3-22, H3-23 and H3-24: The association between Unproven Knowledge and Compatibility with Imposed Practices, Compatibility with Preferred Practices and Compatibility with Past Experiences with Technology.

Figure 31: PLS Results – Relationship between Absorptive Capacity and Compatibility

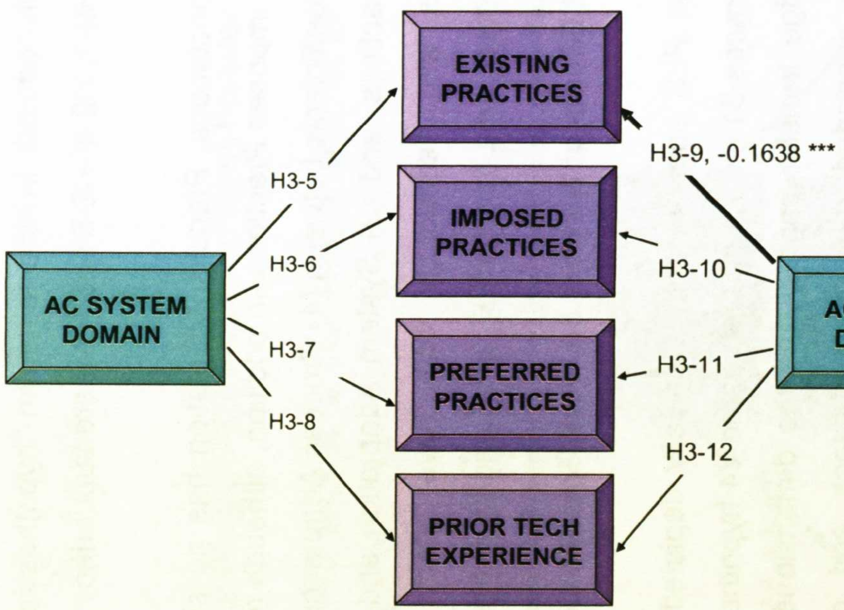


Figure 32: PLS Results – Relationships between Arduous Relationship, Resistance and Compatibility

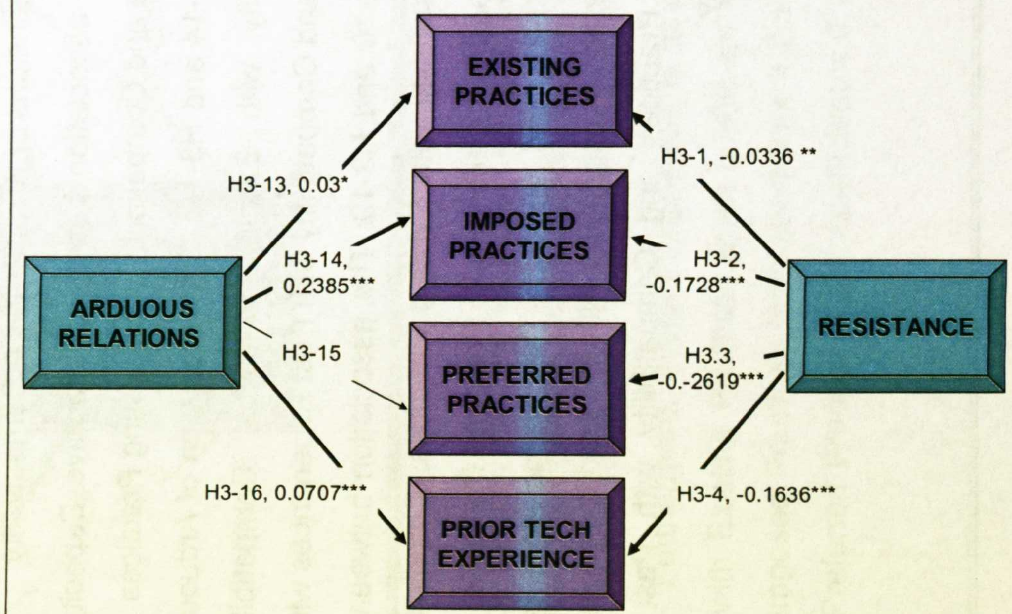
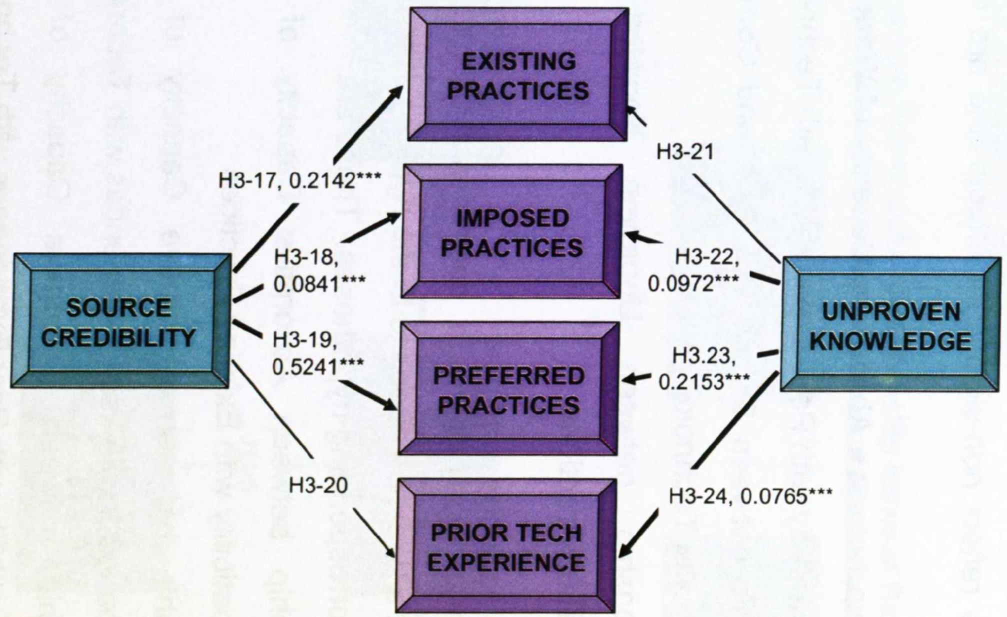


Figure 33: PLS Results – Relationships between Source Credibility, Unproven Knowledge and Compatibility



Two of the hypothesized relationships are unsupported as the relationships reflected both non-significant effects as well as effects opposite to the expected directions, namely

- H3-7: The relationship between Absorptive Capacity of System Knowledge and Compatibility with Preferred Practices.
- H3-10: The relationship between Absorptive Capacity of Work Domain Knowledge and Compatibility with Imposed Practices.

Three of the hypotheses reflect non-significant effects and are therefore unsupported, namely:

- H3-12: The relationship between Absorptive Capacity of Work Domain Knowledge and Compatibility with Past Experiences with Technology
- H3-20: The relationship between Source Credibility and Compatibility with Past Experiences with Technology
- H3-21: The relationship between Unproven Knowledge and Compatibility with Existing Practices.

Finally, although the five remaining path coefficients are statistically significant, they all reflect a direction opposite to the hypothesized direction, thus not supporting the corresponding hypotheses. These are:

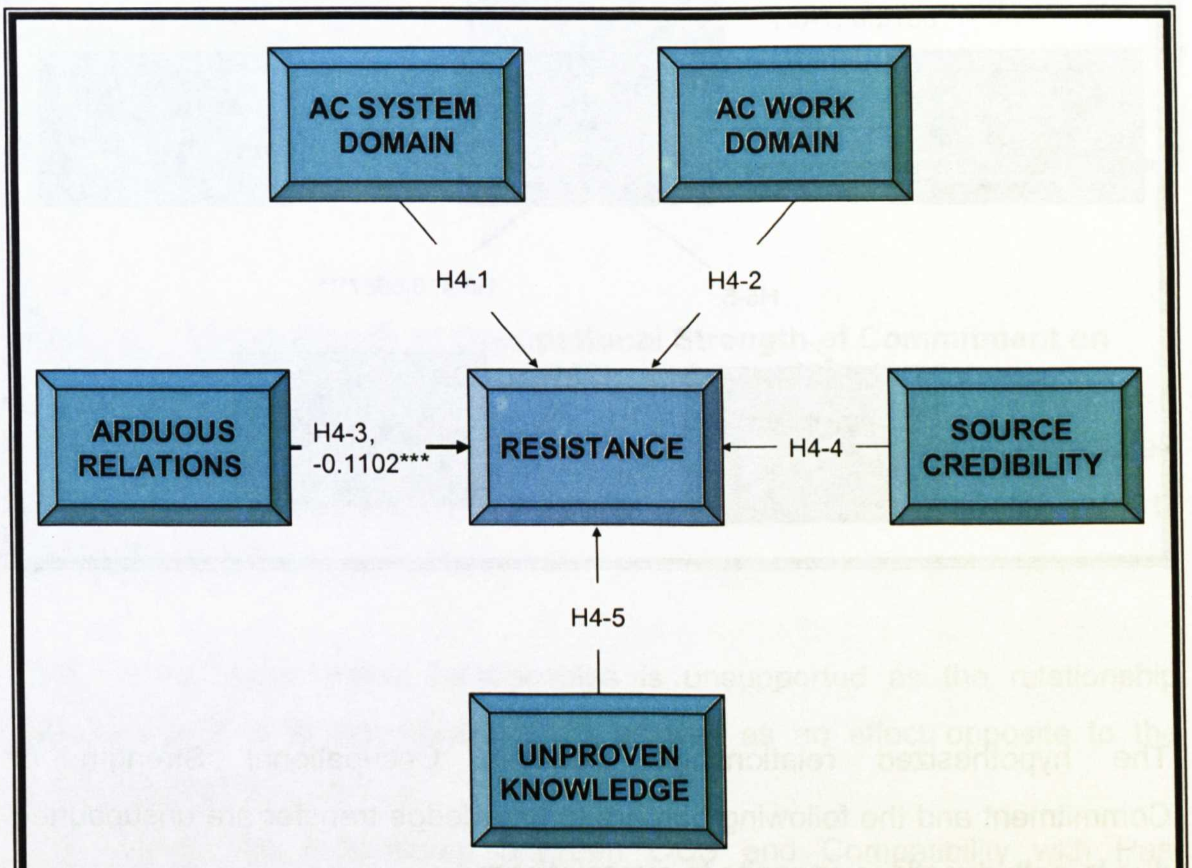
- H3-5: The relationship between Absorptive Capacity of System Knowledge and Compatibility with Existing Practices
- H3-6: The relationship between Absorptive Capacity of System Knowledge and Compatibility with Past Experiences with Technology
- H3-8 The relationship between Absorptive Capacity of System Knowledge and Compatibility with Past Experiences with Technology
- H3-11: The relationship between Absorptive Capacity of Work Domain Knowledge and Compatibility with Preferred Practices
- H3-15: The relationship between Arduous Relationship and Compatibility with Preferred Practices.

9.4.2.4. Direct Effects of other Barriers on Resistance

Although all path coefficients are statistically significant, only the path between Arduous Relationship and Resistance reflects the hypothesized direction. As reflected in Figure 34, H 4-3 is supported, with the hypothesized relationships between Resistance and following barriers being unsupported:

- H4-1: Absorptive Capacity of System Knowledge
- H4-2: Absorptive Capacity of Work Domain Knowledge
- H4-4: Source Credibility
- H4-5: Unproven Knowledge

Figure 34: PLS Results - Relationship between Resistance and other Barriers

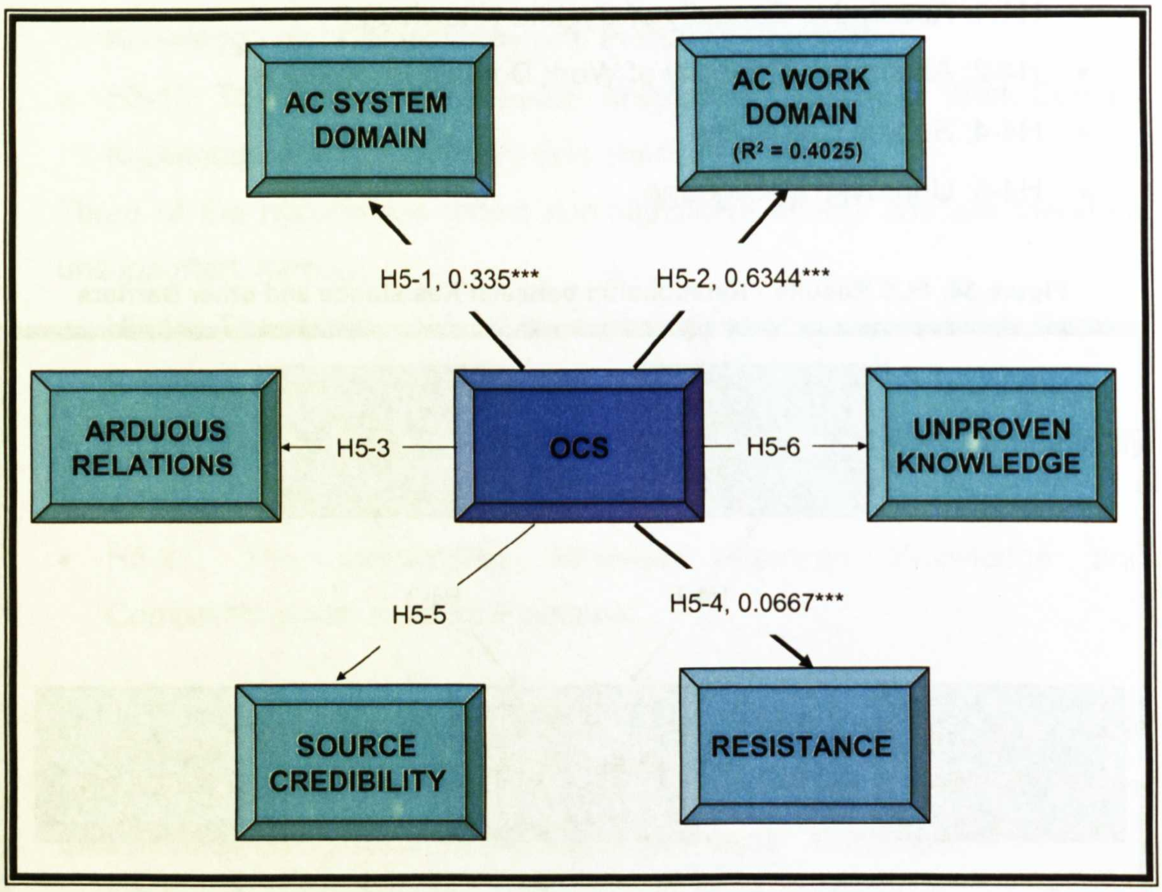


9.4.2.5. Direct Effects of OCS on Barriers

Despite all path coefficients being statistically significant at the 1% level, only three of the six paths reflect the hypothesized direction. As reflected in Figure 35, the hypothesized relationships between Occupational Community of Practice Strength of Commitment and the following barriers to knowledge transfer are supported:

- H5-1: Absorptive Capacity of System Knowledge
- H5-2: Absorptive Capacity of Work Domain Knowledge
- H5-4: Resistance

Figure 35: PLS Results - Relationship between OCS and Barriers



The hypothesized relationships between Occupational Strength of Commitment and the following barriers to knowledge transfer are unsupported due to path directions opposite to expectations:

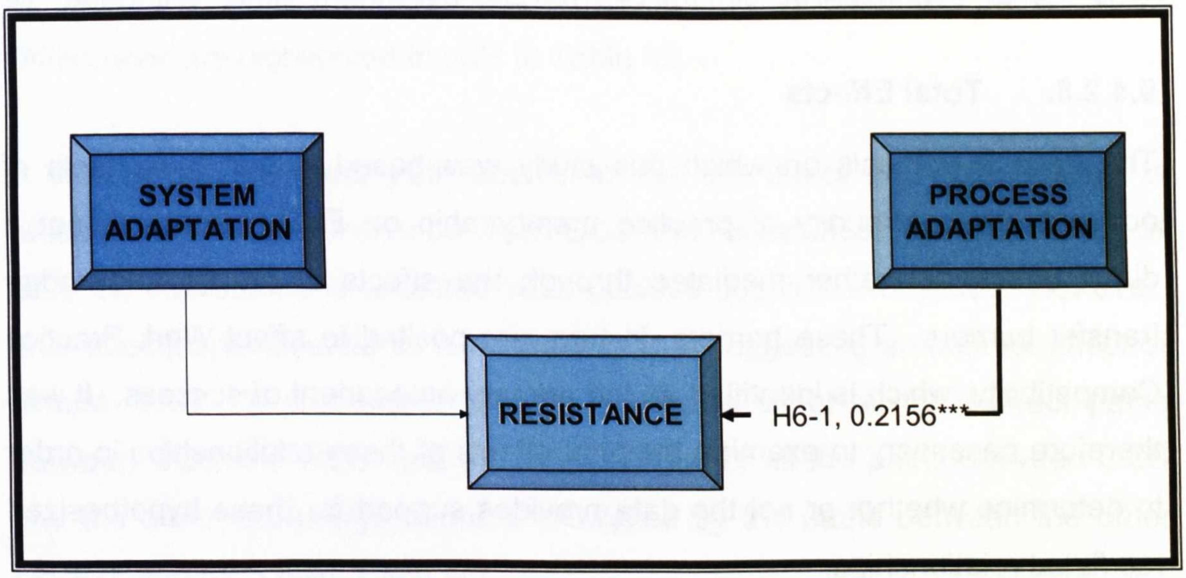
- H5-3: Arduous Relationship
- H5-5: Source Credibility
- H5-6: Unproven Knowledge

9.4.2.6. Direct Effects of Adaptation on Resistance

Both path coefficients are significant at the 1% level and both reflect a positive effect. As System Adaptation was hypothesized to reflect a negative path with

Resistance, H6-2 is unsupported. The path between Process adaptation and Resistance is consistent with expectation (path coefficient = 0.2156, p<0.001), and therefore H6-1 is supported, as depicted in Figure 36.

Figure 36: PLS Results - Relationships between Adaptation and Resistance



9.4.2.7. Direct Effects of Occupational Strength of Commitment on Work Practice Compatibility and Perceived Usefulness

Consistent with expectations, OCS is negatively and significantly associated with Compatibility with Preferred Practices (path coefficient = -0.0459, p<0.01) and therefore H7-3 is supported.

One of the hypothesized relationships is unsupported as the relationship reflected both a non-significant effect as well as an effect opposite to the expected direction, namely

- H7-4: The relationship between OCS and Compatibility with Past Experiences with Technology

The relationship between OCS and Perceived Usefulness - H7-5 - is unsupported because it has a non-significant effect.

Two of the hypothesized relationships, although significant at the 1% level, are unsupported as they both reflect effects opposite to the hypothesized direction. These are the relationships between OCS and

- H7-1: Compatibility with Existing Practices
- H7-2: Compatibility with Imposed Practices.

9.4.2.8. Total Effects

The base hypothesis on which this study was based is that the effects of occupational community of practice membership on ERP success is not a direct effect, but rather mediated through the effects of on the knowledge transfer barriers. These barriers, in turn, are posited to affect Work Practice Compatibility, which is identified as the primary antecedent of success. It was therefore necessary to examine the total effects of these relationships in order to determine whether or not the data provides support for these hypothesized mediated relationships.

The total effects reflect the indirect effects of all the variables on the relationship between OCS and Perceived Usefulness, and the indirect effect of all the variables in the model (except for Perceived Usefulness) on the relationships between OCS and the dimensions of Work Practice Compatibility.

As reflected in Table 45, four of the five path coefficients in this set of relationships changed direction; and two of the significance values increased from non-significant to significant at the 1% level. Once again, the changes in R^2 levels do not warrant further analysis. However, in contrast to the lack of support found for the related hypotheses, the changes result in all the hypothesized relationships between OCS and the dimensions of Work Practice Compatibility to be supported, and the hypothesized relationship between OCS and Perceived Usefulness to be unsupported. Thus, in contrast to the direct effects, H7-1 – H7-4 are supported when considering the total effects of the relationships. H7-5 is unsupported from both a total and direct effect perspective.

It is equally important to evaluate the total effects of certain latent variables on one another, as considerable direct relationships may become insignificant after including additional indirect relationships (Henseler & Fassott, 2009). In such instances, the total effect should remain at a relatively constant, sizable level, thus providing more reasonable grounds for hypothesis support. Should the total effect differ substantially, this suggests that further analysis is required to determine what mediating and/or moderating effects may be at play. Differences are highlighted in bold in Table 45.

A substantially different path coefficient for the direct and total effects is reflected for the relationship between OCS and Resistance: the direct effect of OCS on Resistance is reflected as a positive coefficient of 0.067. However, total effects are reflected as a negative 0.128, suggesting an indirect effect of almost -0.19. These indirect effects are made up of all the indirect paths between OCS and RES, and therefore consist of all the paths between OCS and the other knowledge barriers, multiplied by the paths between the other barriers and RES (see Table 46).

The R^2 of both the direct effects and total effects of OCS on RES are minimal (0.44% and 1.63% respectively) and thus further analysis to determine mediating and/or moderating effects of the knowledge barriers are deemed unwarranted. However, it is noted that in terms of support for the corresponding hypothesis, whilst the direct effects of this relationship supports hypothesis H5-4, the total effects does not support the hypothesis.

Table 46: Indirect Effects between OCS and Resistance

Indirect Effects of the relationship between OCS and RES
OCS → UK → RES
OCS → AR → RES
OCS → SC → RES
OCS → ACW → RES
OCS → ACS → RES

. Differences in total and direct effects are also noted for the following:

- Relationships between all the knowledge transfer barriers (except Resistance) and the dimensions of Work Practice Compatibility.

The total effects reflect the effects of Resistance on these relationships. The path sign for the ACW and Compatibility with Past Experiences with Technology relationship changes from negative to positive, suggesting an indirect effect of 0.03 which is attributable to the indirect effect of Resistance on this relationship. However, the significance of both the direct and total effects remain as non-significant, and therefore no further analysis is deemed warranted for this relationship.

- The relationships between the dimensions of Work Practice Compatibility and PA and SA

Once again, the total effects reflect the effects of Resistance on the relationships. The path sign for the relationship between PA and WPI changes from positive to negative and the effect becomes significant at the 90% level. However, the R^2 of the total effects of this relationship is less than 1%. However, whilst the direct effects of this relationship leave the related hypothesis unsupported, the total effects provide support for the hypothesis (H2-2).

The significance of the relationship between PA and Compatibility with Preferred Practices changes from significant at the 1% to non-significant when accounting for the indirect effects of Resistance. However, the R^2 of the direct effects are minimal at less than 1% and therefore the change to a non-significant effect is deemed trivial.

For SA and the other paths of PA, the path signs remain stable as do the R^2 values.

Once again, therefore, further analysis to determine mediating and/or moderating effects of the RES variable on the PA and SA relationships with the dimensions of compatibility are deemed unwarranted.

9.4.3. Additional Relationships

The structural model did not cover all possible relationships. For parsimonious reasons, and to ensure that the sample size was adequate to meet the requirements of a PLS-SEM analysis, the following categories of relationships were not included in the structural model:

- Relationships between barriers to knowledge transfer
- Relationships between barriers and PU
- Relationships between adaption and barriers (other than Resistance)
- Relationships between the dimensions of work practice compatibility.

The inter-construct correlation matrix (Table 42), however, reflects several significant correlations ($p < 0.001$) within these categories that were not tested in the PLS model. These correlations are reflected in Table 47 and are discussed in more detail in Chapter 10.

Table 47: Additional Relationships identified in inter-construct correlation matrix

Correlation	R	R-squared	Relationship Category
AR – ACS	0.29	8.5	Inter-barrier
UK – ACS	0.59	35.5	Inter-barrier
UK – SC	0.27	7.40	Inter-barrier
AR - ACW	0.31	9.61	Inter-barrier
SC - ACW	0.27	7.29	Inter-barrier
UK - ACW	0.38	14.44	Inter-barrier
SC - AR	0.63	39.89	Inter-barrier
UK - AR	0.38	14.42	Inter-barrier
SC - PU	0.57	32.30	Barrier - PU
AR - PU	0.40	16.18	Barrier - PU
SA – SC	0.29	8.92	Adaptation - barrier
SA - UK	0.35	11.95	Adaptation - barrier
WPI – WPE	0.39	15.87	Inter-dimensional

WPP – WPE	0.52	27.12	Inter-dimensional
WPP – WPI	0.58	33.64	Inter-dimensional

All other correlations reflected in the inter-construct correlation matrix are reflected in the structural model. It is therefore reasonable to suggest that all possible relationships have been identified through the combination of the matrix and the structural model.

9.5. Summary

As reflected in Table 44, approximately 68% of the variance in Perceived Usefulness, 36% of the variance in Compatibility with Existing Practices, 37% of the variance in Compatibility with Imposed Practices, 46% of the variance in Compatibility with Preferred Practices, 31% of the variance in Compatibility with Past Experiences with Technology, and 40% of the variance in ACW are explained.

The model appears to be a good fit for the hypothesized relationships between work practice compatibility and (1) resistance, (2) source credibility, (3) unproven knowledge, (4) arduous relationships, and (5) system adaptation, as well as the relationships between two of the dimensions of work practice compatibility and perceived usefulness.

However, the hypothesized effects of (1) absorptive capacity of system domain and work domain knowledge on work practice compatibility, (2) knowledge transfer barriers on resistance, (3) process adaptation on work practice compatibility, and (4) the effects of OCS on the barriers are mainly unsupported.

Table 48 provides a summary of the hypothesized relationships, whether or not they are supported by the data in terms of direct and total effects, and the magnitude of the effects.

Table 48: Summary of Findings

No	Hypothesis	Notes	Supported / Unsupported	Magnitude of Effect
	Effects of WPC on PU, specifically			
H1-1	Increased perceptions of WPE will enhance perceptions of usefulness	WPE → PU = +ve	Unsupported	Non-significant
H1-2	Increased perceptions of WPI will enhance perceptions of usefulness	WPI → PU = +ve	**Supported**	Trivial
H1-3	Increased perceptions of WPP will enhance perceptions of usefulness	WPP → PU = +ve	**Supported**	**Substantial**
H1-4	Increased perceptions of WPT will enhance perceptions of usefulness	WPT → PU = +ve	Unsupported	Trivial
	Effects of Process Adaption on WPC, specifically			
	Process adaptation to suit the Best Practices embedded within the system will decrease perceptions of compatibility with			
H2-1	Existing work practices	PA → WPE = -ve	**Supported**	Trivial
H2-2	Imposed work practices	PA → WPI = -ve	Unsupported	
			Direct - Supported	Trivial
H2-3	Preferred work practices	PA → WPP = -ve	Indirect - Unsupported	
H2-7	Prior technological experience	PA → WPT = -ve	**Supported**	Trivial
	Effects of System adaptation on WPC, specifically:			
H2-4	System adaptation to suit existing work practices will enhance perceptions of compatibility with existing work practices	SA → WPE = +ve	**Supported**	**Trivial**
H2-5	System adaptation to suit imposed work practices will enhance perceptions of compatibility with imposed work practices	SA → WPI = +ve	**Supported**	**Trivial**
H2-6	System adaptation to suit preferred work practices will enhance perceptions of compatibility with preferred work practices	SA → WPP = +ve	**Supported**	**Trivial**
H2-8	System adaptation to prior technological experience will enhance perceptions of compatibility with prior technological experience	SA → WPT = +ve	Unsupported	

No	Hypothesis	Notes	Supported / Unsupported	Magnitude of Effect
	Effects of Barriers on WPC, specifically:			
	Increased resistance will decrease perceptions of Compatibility with			
H3-1	Existing work practices	RES → WPE = -ve	**Supported**	Trivial
H3-2	Imposed work practices, and	RES → WPI = -ve	**Supported**	Trivial
H3-3	Preferred work practices	RES → WPP = -ve	**Supported**	Trivial
H3-4	Prior technological experience	RES → WPT = -ve	**Supported**	Trivial
Increased Absorptive capacity of System Domain knowledge will decrease perceptions of Compatibility with				
H3-5	Existing work practices	ACS → WPE = -ve	Unsupported	
H3-6	Imposed work practices, and	ACS → WPI = -ve	Unsupported	
H3-7	Preferred work practices	ACS → WPP = -ve	Unsupported	
H3-8	Prior technological experience	ACS→ WPT = -ve	Unsupported	
Increased Absorptive capacity of Work Domain knowledge will decrease perceptions of Compatibility with				
H3-9	Existing work practices	ACW → WPE = -ve	**Supported**	Trivial
H3-10	Imposed work practices, and	ACW → WPI = -ve	Unsupported	
H3-11	Preferred work practices	ACW → WPP = -ve	Unsupported	
H3-12	Prior technological experience	ACW → WPT = -ve	Unsupported	
Increased Arduous Relationship will decrease perceptions of Compatibility with				
H3-13	Existing work practices	AR → WPE = +ve	**Supported**	Trivial
H3-14	Imposed work practices, and	AR → WPI = +ve	**Supported**	Trivial
H3-15	Preferred work practices	AR → WPP = +ve	Unsupported	
H3-16	Prior technological experience	AR → WPT = +ve	**Supported**	

No	Hypothesis	Notes	Supported / Unsupported	Magnitude of Effect
Increased Source Credibility will increase perceptions of Compatibility with				
H3-17	Existing work practices	SC → WPE = +ve	**Supported**	Trivial
H3-18	Imposed work practices, and	SC → WPI = +ve	**Supported**	Trivial
H3-19	Preferred work practices	SC → WPP = +ve	**Supported**	Weak
H3-20	Prior technological experience	SC → WPT = +ve	Unsupported	
Increased perceptions of Unproven Knowledge will decrease perceptions of Compatibility with				
H3-21	Existing work practices	UK → WPE = +ve	Unsupported	
H3-22	Imposed work practices, and	UK → WPI = +ve	**Supported**	Trivial
H3-23	Preferred work practices	UK → WPP = +ve	**Supported**	Trivial
H3-24	Prior technological experience	UK → WPT = +ve	**Supported**	Trivial
	Effects of Barriers on each other, specifically:			
H4-1	An increase in ACS will lead to higher levels of Resistance	ACS → RES = +ve	Unsupported	
H4-2	An increase in ACW will lead to higher levels of Resistance	ACW → RES = +ve	Unsupported	
H4-3	The less arduous the relationship, the less the levels of resistance	AR → RES = -ve	**Supported**	Trivial
H4-4	The more credible the source is viewed to be, the less resistance	SC → RES = -ve	Unsupported	
	An increased shared understanding will reduce Resistance	SU → RES = -ve	Removed	
H4-5	The more useful the knowledge has been proven to be, the less the levels of resistance will be	UK → RES = -ve	Unsupported	
	Effect of OCS on Knowledge Transfer Barriers			
	A strong commitment to an occupational community of practice will:			
H5-1	increase ACS	OCS → ACW = +ve	Supported	**Substantial**
H5-2	increase ACW	OCS → ACS = +ve	**Supported**	Trivial

No	Hypothesis	Notes	Supported / Unsupported	Magnitude of Effect
H5-3	increase Arduous Relationship	Reverse coded, thus: OCS → AR s/be -ve	Unsupported	
H5-4	increase Resistance	OCS → RES = +ve	**Direct – supported** Total - unsupported	Trivial
H5-5	decrease Source Credibility	OCS → SC = -ve	Unsupported	
H5-6	increase perceptions of Unproven Knowledge	Reverse coded, thus: OCS → UK s/be -ve	Unsupported	
	decrease Shared Understanding	OCS → SU = -ve	Removed	
	Effects of Adaptation on Barriers, specifically			
H6-2	System adaptation to suit user requirements will reduce resistance	SA → RES = -ve	Unsupported	
H6-1	Process adaptation to suit embedded Best Practices will increase resistance	PA → RES = +ve	**Supported**	Trivial
	Effects of OCS on WPC and PU			
	Increased strength of occupational commitment will decrease perceptions of compatibility with			
H7-1	Existing work practices	OCS → WPE = -ve	Direct – Unsupported Total - Supported	Trivial
H7-2	Imposed work practices	OCS → WPI = -ve	Direct – Unsupported Total - Supported	Trivial
H7-3	Preferred work practices	OCS → WPP = -ve	Supported	Trivial
H7-4	Prior technological experience	OCS → WPT = -ve	Direct – Unsupported Total - Supported	Trivial
H7-5	Increased strength of commitment to Occupational Communities of Practice will decrease perceptions of usefulness	OCS → PU = -ve	Unsupported	

CHAPTER 10

THE FACTORS INFLUENCING ERP SUCCESS

"Foolish consistency is the hobgoblin of little minds..."

Ralph Waldo Emerson (1803 – 1882)

10.1. Introduction

This chapter presents an interpretation of the findings reported in the previous chapter in two distinct ways. Firstly, the results are interpreted within the framework of the research questions set out in section 5.5. The answer to each question, therefore, is provided in Section 10.2

Although the data provides little support for the original hypothesis that occupational strength of commitment has an important role to play in ERP success, the findings suggest that Compatibility with Preferred Practices plays a significant role. This factor, and its related antecedents, is discussed in Section 10.3.

10.2. The Relationship between Occupational Strength of Commitment and ERP Success

As discussed in Section 8.2.2, the theory on which the research model is based is that occupational strength of commitment will interfere with the knowledge transfer process, reducing the ability of the consultants and users to mutually adapt the system to suit the users' needs in terms of existing, past, preferred and imposed working practices. Work Practice Compatibility, in turn, was hypothesized to be a substantial factor in explaining the variance in Perceived Usefulness, which is the construct used to measure ERP success.

Consequently, the structural relationships within the research model can be partitioned into three groups, with each group representing a sub-question of the overall research question. These are reflected in Table 49.

Table 49: Structural Relationship Groupings

Group	Relationships	Research Question	Section
1	The relationships between the dimensions of Work Practice Compatibility and Perceived Usefulness	What is the relationship between Work Practice Compatibility and self-perceived individual performance?	10.2.2
2	The relationships between the barriers, adaptation, and Work Practice Compatibility,	What is the relationship between adaptation, knowledge transfer barriers and Work Practice Compatibility?	10.2.3
3	The relationship between OCS and the knowledge transfer barriers	What is the relationship between OCS and knowledge transfer barriers?	10.2.4

This section begins with a discussion of the overall relationship between OCS and Work Practice Compatibility (10.2.1).

10.2.1. The Relationship between OCS and Work Practice Compatibility

The observed direct effects provide no support for the hypothesized relationships between OCS and the dimensions of Work Practice Compatibility. However, the picture changes when viewing the total effects of these relationships: when taking into consideration all the paths, direct and indirect, between OCS and the dimensions of Work Practice Compatibility, the data reflects that there are significant correlations between the former and each of the latter. Nonetheless, the effect sizes of these relationships are minimal, ranging between 3% and 11%. Based on these findings, two important conclusions can be drawn:

1. Overall, OCS has little explanatory power in terms of the variances in the dimensions of Work Practice Compatibility within the context of ERP system success.
2. Consistent to expectations, the effects of OCS on Work Practice Compatibility are mediated by knowledge transfer barriers and adaptation. The significance of these relationships and their potential implications for ERP success are discussed in the remainder of this chapter.

10.2.2. The Relationship between Work Practice Compatibility and Perceived Usefulness

Only two of the four hypothesized relationships in this group were supported. Consistent with expectations, the data suggests that users who perceive the system to be compatible with their preferred and imposed work practices will perceive the system to have higher levels of usefulness in their job performance than those users who perceive the system to be incompatible with their preferred and imposed work practices.

Of the 68% total variance in Perceived Usefulness explained by the model, Compatibility with Preferred Practices explains almost 57% of the variance, with 1.36% explained by Compatibility with Imposed Practices and the remaining 8% explained by other variables in the model. As a result, Compatibility with Preferred Practices can be seen to be very important in terms of ensuring that the system leads to increased job performance, and thus to attaining the expected benefits of ERP system adoption. In contrast, Compatibility with Imposed Practices is relatively unimportant in terms of achieving ERP success.

These results are somewhat inconsistent with prior related research. Compatibility with Preferred Practices was found to load with Relative Advantage (or Perceived Usefulness) in three other prior studies (Compeau et al., 2007; Karahanna et al., 2006; Moore & Benbasat, 1991), and was therefore excluded from the analysis in two of these studies. However, both these constructs were retained in this study as the results of the measurement model (see. section 9.4.1.3) reflected sufficient discriminant validity. In contrast, the findings regarding the relationship between Compatibility with Imposed Practices and Perceived Usefulness are consistent with those reported by both Karahanna et al (2006) and Compeau et al (2007), who reported positive path coefficient of 0.1165 and 0.30 respectively.

The two hypotheses that were not supported relate to Compatibility with Existing Practices and Compatibility with Past Experiences with Technology. The relationship between Perceived Usefulness and Compatibility with Past Experiences with Technology, while significant, was negative and in the opposite direction than hypothesized. It had been hypothesized that the more compatible the system is perceived to be to the users' prior technical knowledge, the higher the users' perceptions of the usefulness of the system. However, the results show the opposite – the less compatible, the more useful the system is perceived to be. Furthermore, the findings reflect no significant correlations between Compatibility with Existing Practices, indicating that contrary to expectations, a system that maintains a high level of consistency with previous practices does not affect users' perceptions of increased job performance.

A comparison of these findings with prior related research exposes both inconsistencies and similarities. Firstly, the negative correlation between Compatibility with Past Experiences with Technology and Perceived Usefulness is consistent with Karahanna et al.'s (2006) findings, but inconsistent with Compeau et al.'s (2007) study. Secondly, the lack of significant correlation between Compatibility with Existing Practices and Perceived Usefulness is inconsistent with Karahanna et al.'s study, who reported a positive and significant relationship between these two variables. However, examination of their item scales reveals that Perceived Usefulness was measured in terms of perceptions of the future, rather than perceptions of actual use. For example, the question "Using the system **will** make it easier to do my job", asks the user to predict the impact of the system on their job performance. In contrast, the questions used for this study asked users to report on actual use – for example "Using the system **makes** it easier to do my job". Thus it is possible that the construct being measured in Karahanna et al.'s study is somewhat different to the one being measured in this study.

As a way of explaining the unexpected negative correlation between Compatibility with Past Experiences with Technology and Perceived Usefulness, Karahanna et al suggested that users with experience in equivalent systems would not be as impressed as those who are unfamiliar with such systems.

However, the observed lack of significant correlation between existing work practices and perceived usefulness, and the negative correlations between Compatibility with Past Experiences with Technology and Perceived Usefulness suggests an alternative explanation that is supported in part by the literature. Compeau et al. posited that "prior experience shapes our mental models of an innovation" (Compeau et al., 2007, p.416); therefore, a new system that is similar to those that have been used previously will be perceived as easier to use than those that are unfamiliar. Their findings support this hypothesis, reflecting a positive path coefficient between Compatibility with Past Experiences with Technology and Perceived Usefulness. Although their study did not test the relationship between Compatibility with Existing Practices and Perceived Usefulness, the same argument can apply: a new system that maintains similar practices to those that have been used previously will be perceived as easier to use than those that require significant changes to working practices.

It is equally possible therefore that those systems that do nothing other than provide the same working practices as before could be viewed as a waste of effort as it will do nothing to enhance job performance. Similarly, if the system is providing similar functionality to that of an existing system, the users may feel that the system is not providing any relative advantage to their job performance, thus users cannot see how the system can enhance their job performance. This is further supported by the argument that "previous practices and experiences serve as a standard against which an innovation can be interpreted" (Van Slyke et al., 2008, p.60) – what is being suggested here is that users are comparing the new system with the old system and not finding any differences because the same practices are being implemented, and therefore they are unable to see any increased advantage in using the new system

It is acknowledged that this explanation is partly in direct opposition to the generally accepted views in the literature that "innovations that fit well with existing or desired practices or values may be more desirable than those that do not" (Van Slyke et al., 2008. p.60). However, both Compeau et al.'s (2007) findings as well as this study's findings suggest that consistency with existing practices is a matter for ease of use rather than perceived usefulness. In addition, the expected and observed correlation between Perceived Usefulness and Compatibility with Preferred Practices does support this general view – the data reflects that users perceived the system to have a higher usefulness to them, and therefore more "desirable", when it was perceived to accommodate their preferred ways of working.

Overall, these findings suggest that Work Practice Compatibility and Perceived Usefulness (as operationalised for, and within the context of, this study) are separate and distinct constructs, and that Compatibility to Preferred Practices is an important antecedent to Perceived Usefulness. As discussed in section 8.2.2, these findings are inconsistent to other researchers who have argued that Relative Advantage and Compatibility are a single complex structure (Moore & Benbasat, 1991), and that Perceived Usefulness and Compatibility to Preferred Practices are a single construct (Compeau et al., 2007; Karahanna et al,, 2006).

Due to the inconsistencies in the literature, further research into these relationships is required before these findings and explanations can be accepted.

10.2.3. The Relationship between Work Practice Compatibility, Barriers and Adaptation

For ease of reading, the relationships are further decomposed into the following four sets:

1. The relationship between Adaptation and Work Practice Compatibility

2. The relationship between Adaptation and Barriers to Knowledge Transfer

3. The relationship between Barriers and Work Practice Compatibility

4. The inter-relationships between Barriers to Knowledge Transfer

Each of these is discussed in turn below.

10.2.3.1. The relationship between Adaptation and Work Practice Compatibility

Path coefficients for process and system adaption do not support all the hypothesized relationships to work practice compatibility. As expected, the higher the users' perceptions that the system has been adapted to accommodate their needs, the higher their perceptions of compatibility in terms of existing, imposed and preferred work practices. However, the opposite seems to hold true for compatibility with prior experience: the higher the user's perceptions that the system has been adapted, the lower their perceptions of compatibility with prior experience with technology. This could indicate that the system has been adapted to something completely unique and outside the prior experience of the users ("Using the system is not similar to anything that I have done before"), even though the system still maintains consistency with preferences, imposed practices and existing practices. Further research is required to validate this explanation.

Similarly, and as hypothesized, the more users perceive their own processes to have been adapted to suit the embedded practices within the system, the lower their perceptions of compatibility in terms of existing practices and prior experience with technology. In contrast, the data reflects that there is no significant correlation between perceptions of imposed practices and process adaptation. Further, the findings suggest that preferred work practices are increased when there are perceptions of increased adaption of their own processes. This could indicate that the adaptation efforts are in fact helping users to change their existing ways of working to better suit their preferred ways of working. Once again, however, further investigation is required to gain empirical support for this suggestion.

10.2.3.2. The relationship between Adaptation and Barriers

It was expected that the higher the users' perceptions that the system has been adapted to accommodate their needs, the lower their resistance would be to the new system. The path coefficient between these two variables reflects the opposite – the higher the perceptions of system adaptation, the higher the resistance.

In contrast, it was expected that the higher the perceptions that users' processes were adapted to accommodate the new system, the higher the users' resistance to the system would be. This hypothesis is supported by the data. Although these findings may appear in conflict with the findings relating to the relationship between process adaptation and Compatibility with Preferred Practices, viewing the timing of the perceptions provides a more consistent explanation. Users' resistance may be enhanced during the implementation period as a result of their processes being adapted (my work processes are being changed and I don't like change); however, during actual use, users discover that these changes have the positive effect of providing them with a system that allows them perform their jobs in their preferred work style,

10.2.3.3. The Relationship between Barriers and Work Practice Compatibility

Table 50 provides a summary of the supported and unsupported hypotheses in this subset of relationships

Table 50: Summary of Relationships between Barriers and Work Practice Compatibility

Barrier	WPE	WPI	WPP	WPT
ACS	No	No	No	No
ACW	Yes	No	No	No
AR	Yes	Yes	No	Yes
RES	Yes	Yes	Yes	Yes
SC	Yes	Yes	Yes	No
UK	No	Yes	Yes	Yes

- **Absorptive Capacity of System Domain Knowledge**

All four of the hypothesized relationships are unsupported, reflecting paths in the direction opposite to those hypothesized. Three of the correlations are significant at the 1% level, with the correlation between ACS and Compatibility with Preferred Practices being insignificant. Thus, contrary to expectations, increased levels of ACS correlate with increased levels of Compatibility with Existing Practices, Compatibility with Imposed Practices and Compatibility with Past Experiences with Technology. Further, ACS explains 7% of the total explained variance (of 36%) in Compatibility with Existing Practices and more than half of the total explained variance (16% of 31%) in Compatibility with Past Experiences with Technology.

The ACS → WPT relationship could be explained by the possibility that users with a lot of experience in using comparable technology could more easily find similarities in the new system. That is, the more experience they have had with using other systems, the more exposure they have had with various functionalities and therefore the more chance that the new system incorporates functions that they have seen before. The same can be said for the ACS → WPE relationship – users may be able to more easily see similarities to existing practices because of their knowledge and familiarity with other similar system, which users who do not have the same understanding and experience may not see.

- **Absorptive Capacity of Work Domain**

Only one of the four hypotheses relating to the relationship between this variable and the dimensions of Work Practice Compatibility was supported by the data, namely the ACW → WPE relationship. The unexpected positive correlation between high levels of ACW and increased perceptions of compatibility with preferred work practices could be explained by the view that preferred work practices are more likely to be developed by users who are more knowledgeable and experienced within their work domains. This view does not however, hold true for perceptions of imposed work practice compatibility, as although the path coefficient is also positive, the correlation is found to be insignificant.

- **Arduous Relationship**

Consistent with hypotheses, ease of relationship between user and implementation team correlates with increased perceptions of Compatibility with Existing Practices, Compatibility with Imposed Practices and Compatibility with Past Experiences with Technology. Unexpectedly, the data reflects that the easier this relationship, the less the system is perceived to be compatible with preferred working practices. No plausible explanation for this finding can be offered at this time and further research is recommended to determine whether similar results are obtained from studies in similar contexts.

- **Resistance**

Consistent with expectations, users with high levels of Resistance will also have decreased perceptions of Work Practice Compatibility for all four sub-dimensions.

- **Source Credibility**

As hypothesized, users who perceive the members of the implementation team to be credible and trustworthy will also have high perceptions of Compatibility with Existing Practices, Compatibility with Preferred Practices and Compatibility with Imposed Practices. Source Credibility also accounts for more than half of the explained variance (27% of 46%) in Compatibility with Preferred Practices – this issue is discussed in more detail in section 10.3. Although the path coefficient in the SC → WPT relationship is also positive, it is insignificant, therefore contrary to expectations, increased levels of SC cannot be said to correlate with increased perceptions of WPT. In hindsight, the lack of correlation in the SC → WPT relationship may be understandable: users may well disregard their perceptions of the source of the knowledge (the implementation team) when faced with the reality of comparing the new system with their prior knowledge and experience.

- **Unproven Knowledge**

Users who perceive the system to be reputable and usable will also have high perceptions of Compatibility with Preferred Practices, Compatibility with

Imposed Practices and Compatibility with Past Experiences with Technology. This is consistent with expectations. The UK → WPE coefficient, whilst also positive, is insignificant, therefore not supporting the hypothesized positive relationship between these two variables.

10.2.3.4. Interrelationships between Barriers

Of the five hypothesized relationships, only one is supported by the data, namely that reduced arduousness of relationship between users and implementers leads to reduced resistance. The other four relationships reflect signs opposite to those hypothesized, suggesting that

- the more proven the knowledge the more resistance increases
- the more credible the implementers are perceived to be by the users, the more resistance increases
- the higher the absorptive capacity of the users in terms of work domain knowledge, the lower the resistance
- the higher the absorptive capacity of the users in terms of prior experience with technology, the lower the resistance

With hindsight, the correlations between Resistance and Absorptive Capacity of Work Domain Knowledge and prior technical experience can make sense. Resistance to new technology could be lowered if users feel that they have sufficient prior knowledge of technology to allow them to learn the new system more easily and more quickly. This is similar to the concept of computer self-efficacy (CSE), which has been defined as *"an individual judgment of one's capability to use a computer"* (Compeau & Higgins, 1995, p.192). CSE has been found to have significant effects on the stress and anxiety of users, as well as the actual performance attained by individuals when using computers (for example Ajzen & Fishbein, 1980; Compeau & Higgins, 1995; Deng, Doll, & Truong, 2004; Marakas, Yi, & Johnson, 1998; Taylor & Todd, 1995; Torkzadeh, Van Dyke, & . 2001), and in particular, when using ERP technologies (for example Calisir, Altin, & Gumussoy, 2009; Kanwal & Manarvi, 2010; Shih, 2006; Shih & Huang, 2009).

Similarly, users with high levels of work domain knowledge may feel confident enough in their abilities to do the job regardless of the technology that is required to be used. Once again however, further research is required to test this theory.

However, the observed positive relationships between unproven knowledge and resistance, and source credibility and resistance cannot be explained. Further research is once again required to determine whether similar results will be obtained in different studies.

10.2.4. The Relationship between OCS and Barriers

The hypotheses that occupational strength of commitment will increase user resistance to the implementation of the new system, increase absorptive capacity of work domain knowledge and absorptive capacity of prior technology knowledge are supported. In addition, OCS accounts for 40% of the variance in ACW, which is the total variance explained in this variable by the model. Additionally, 11% of the 13% total variance explained by the model of ACS is explained by OCS.

In contrast, and in contradiction to the hypothesized relationships, the data suggests that OCS will decrease the arduousness of the relationship between users and implementers; increase the perceived credibility of the implementers and decrease perceptions of unproven knowledge.

One possible explanation for these findings can be drawn from the study reported by Andrews and Delahaye (2000), in conjunction with the relatively new trend of including functional experts in implementation teams. Firstly, Andrews and Delahaye found that people were only willing to share information with others if they trusted them, and sought information from people whose scientific expertise they valued (Easterby-Smith et al., 2006, p.45). Secondly vendors and implementation consultants are now recruiting functional area specialists with prior industry knowledge for the specific purpose of including such experts into implementation teams. This could result in users perceiving such members to be "experts" in their field, and therefore more trustworthy and reliable sources of knowledge and working practices. In this way, rather than users perceiving these team members as outsiders, they would be seen as part of the referent occupational community of practice, and users would be encouraged to share information with them. Furthermore, end-users with high levels of work domain knowledge would be better equipped to relate to such team members, and would thus find that the relationships between themselves and the consultants are less arduous, and that the credibility of the consultants is higher. In addition, the consultant may be in a better position to convince such end-users of the value of the new system through a mutual understanding of the work domain, and therefore users' perceptions of the potential usefulness of the system would be increased.

Further research is required, however, to provide support for this explanation.

10.2.5. Additional Relationships

Additional correlations were identified in the inter-construct correlation matrix, as discussed in section 9.2.3. Because the direction of the relationship is not known, a definitive interpretation of these relationships is not possible. For example, the WPI – WPE correlation could indicate that a high level of compatibility to imposed practices would lead to higher levels of compatibility with existing work practices, or vice versa. The same argument holds true for the other 2 inter-dimensional correlations. Further research is required to determine the direction of the relationship, which is supported by the medium and large effect sizes of these relationships.

Although the same problem affects interpretation of the correlations between barriers, it is interesting to note that three specific correlations suggested in section 4.3.2.5 are reflected in the matrix, namely SC – AR, UK – AR and UK – SC. It is also noteworthy that the SC – AR relationship identified in the matrix is consistent with a previous study that reported that the more credible the source was perceived to be, the less arduous the relationship between the consultant and the user tended to be (Ko et al., 2005). Notwithstanding the support from previous studies, the implications of this relationship, together with all the other inter-barrier correlations, are left for further research.

With regard to the correlations between system adaptation and the barriers to knowledge transfer, the literature ... it would make sense to interpret these as adaptation having an effect on the barriers. As discussed in section 5.4.5, it is reasonable to expect that if the system is adapted to comply with users' accepted practices and needs, the barriers to knowledge transfer would be reduced. Therefore, it is reasonable to interpret the SA – SC and SA – UK correlations in this way. However, further research is required to validate this interpretation.

A similar situation occurs when considering the correlations between perceived usefulness and the two knowledge transfer barriers. In this study, PU, AR and SC were measured in terms of perceptions of actual use and experience, rather than perceptions of the future; in addition, the interaction with consultants was identified as preceding the use of the system. Therefore, it can be reasonably argued that increased source credibility and reduced arduousness of relationship will lead to increased perceptions of usefulness

Therefore, the correlations reflected in the matrix can reasonably be interpreted as Source Credibility explaining 32% of the variance in PU, and arduous relationships explaining 16% of the variance in PU. Once again, however, further research would be required to validate these conclusions.

10.3. Factors explaining variances in Work Practice Compatibility

The above discussion has demonstrated that Compatibility with Preferred Practices is the factor with the strongest influence on Perceived Usefulness in the research model. Knowing this provides the ability to predict ERP success to a large extent. However, to be able to influence ERP success, it is even more important to be able to identify the variables that influence Compatibility with Preferred Practices. It is equally important to identify the variables that have a negative effect on ERP success, so that they can be controlled for.

Not all of the original hypotheses have been supported by the data. As a result, numerous future research studies have been identified in order to continue with the process of fully understanding the factors that increase ERP success. Nevertheless, this study has empirically identified some of the variables that have positive and negative influences on ERP success.

This section consolidates these variables into a set of relationships to form a potential framework for understanding and influencing ERP success. The framework, depicted in Figures 37 – 40, is divided into two groups:

- Group 1, hereafter referred to as Positive Group, reflects the positive influence of Compatibility with Preferred Practices and Compatibility with Imposed Practices on Perceived Usefulness, and working backwards from this starting point then tracks all the variables that this study has empirically demonstrated to explain the variances in these variables. This set of variables therefore theoretically can be used to enhance both Compatibility with Preferred Practices and Compatibility with Imposed Practices, thus enhancing Perceived Usefulness.
- Group 2, hereafter referred to as Negative Group, reflects the negative influences of Compatibility with Existing Practices and Compatibility with Past Experiences with Technology on Perceived Usefulness, and the variables that were empirically found to explain the variances in these variables. This set of variables, therefore, can theoretically be used to decrease both Compatibility with Existing Practices and Compatibility with Past Experiences with Technology, thus once again enhancing Perceived Usefulness.

Given the minimal effects that Compatibility with Imposed Practices, Compatibility with Existing Practices and Compatibility with Past Experiences with Technology were found to have on Perceived Usefulness, the variables influencing these factors are not discussed further and are included in the model only for completeness purposes.

Variables can account for variances in factors in both the Positive and Negative groups. In some cases, the focus of these variables can be adapted so that implementation teams can focus on enhancing the effects of these variables on the Positive factors whilst reducing the effects on the negative factors. Such variables are included in both groups for completeness. The negative effect is indicated using a dotted border, while a solid line border indicates the positive effect. For example, System Adaptation has an effect on Compatibility with Preferred Practices (Positive Group), Compatibility with Imposed Practices (Positive Group) and Compatibility with Existing Practices (Negative Group). To reflect that efforts should be focussed on enhancing Compatibility with Preferred Practices through SA, SA is depicted with a solid line in the Positive Group, and a dotted line in the Negative Group.

Figure 37: Factors Influencing Compatibility with Preferred Work Practices

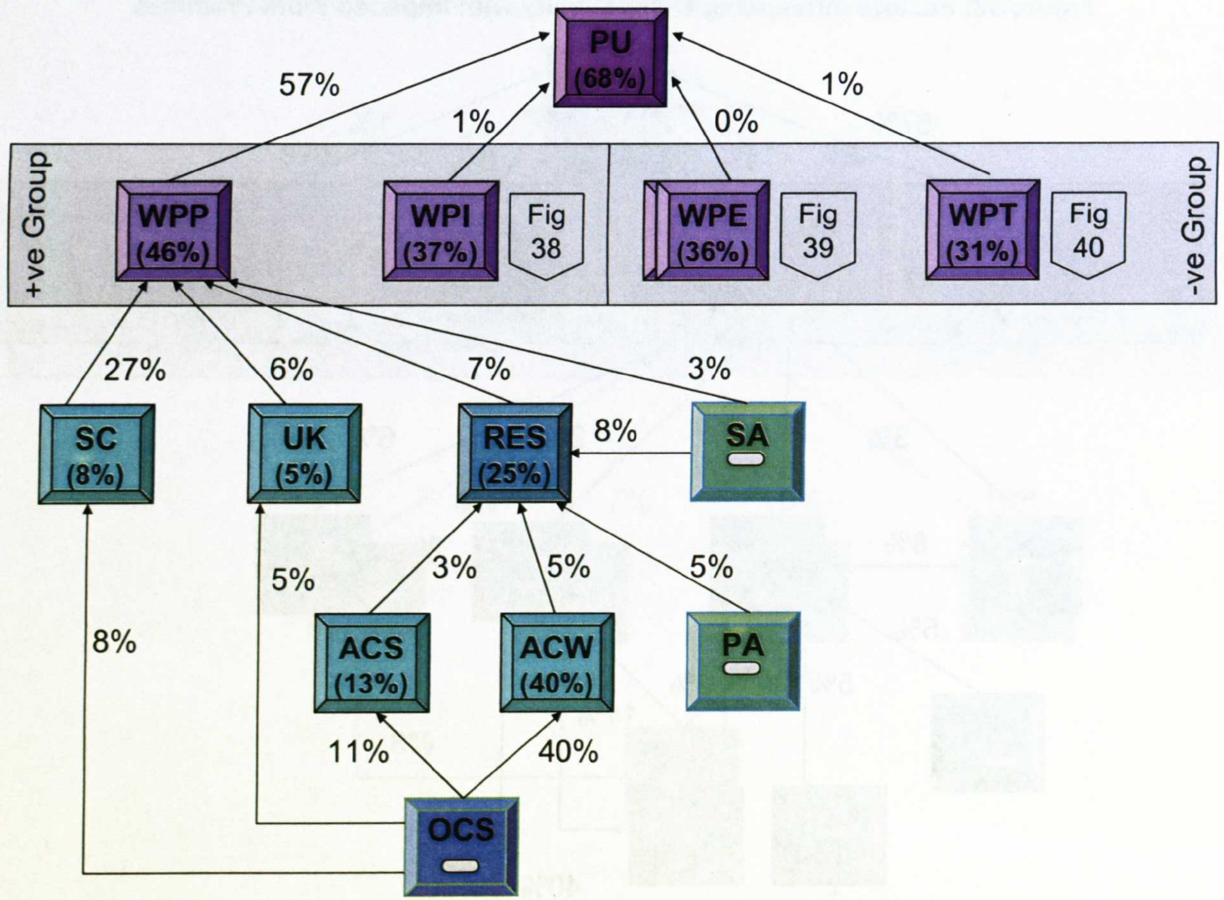


Figure 38: Factors Influencing Compatibility with Imposed Work Practices

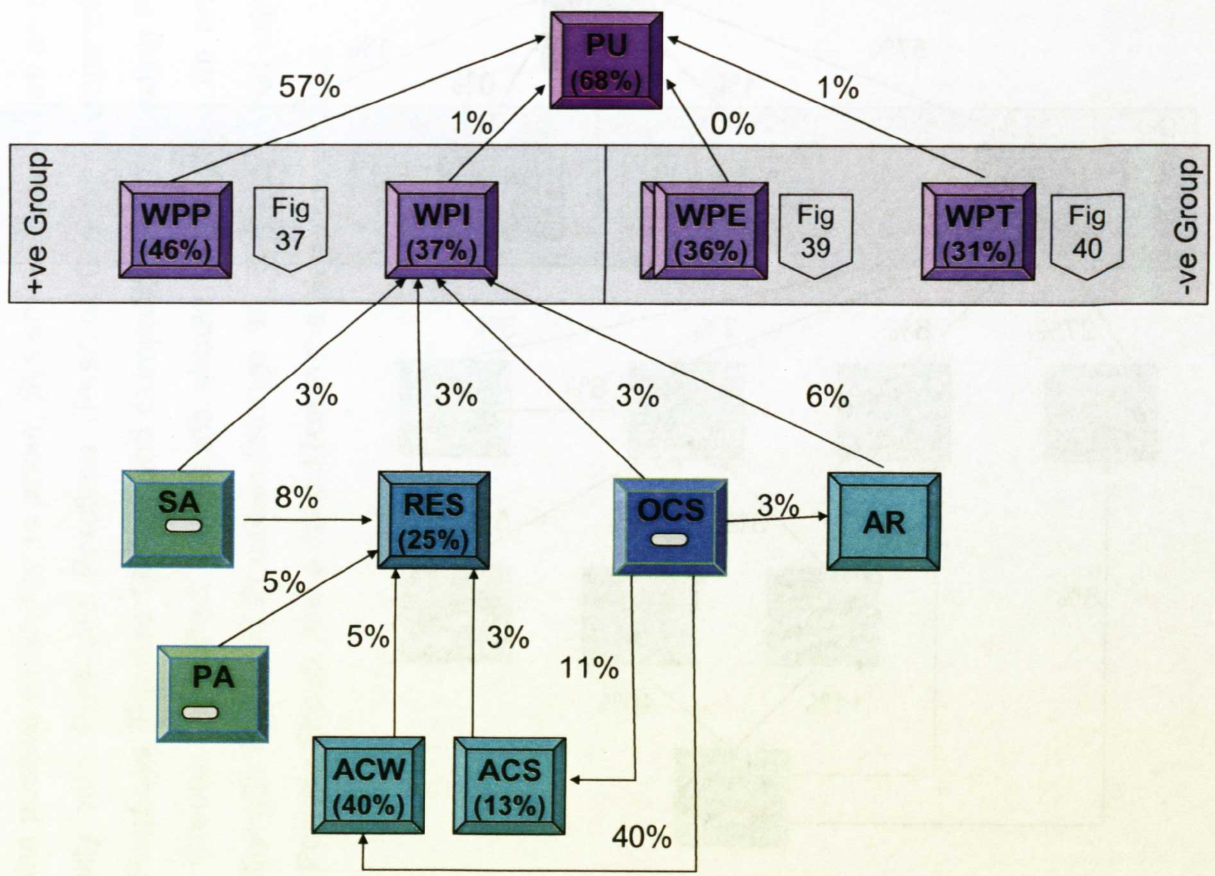


Figure 39: Factors Influencing Compatibility with Existing Work Practices

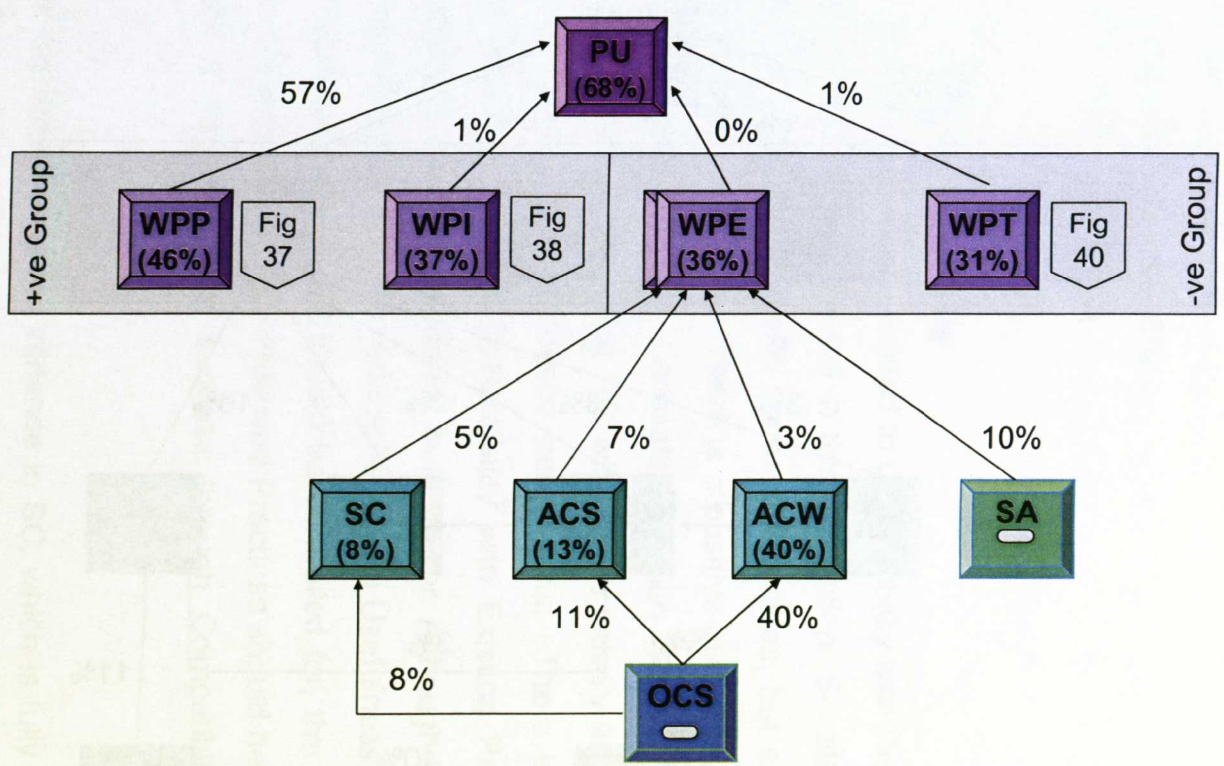
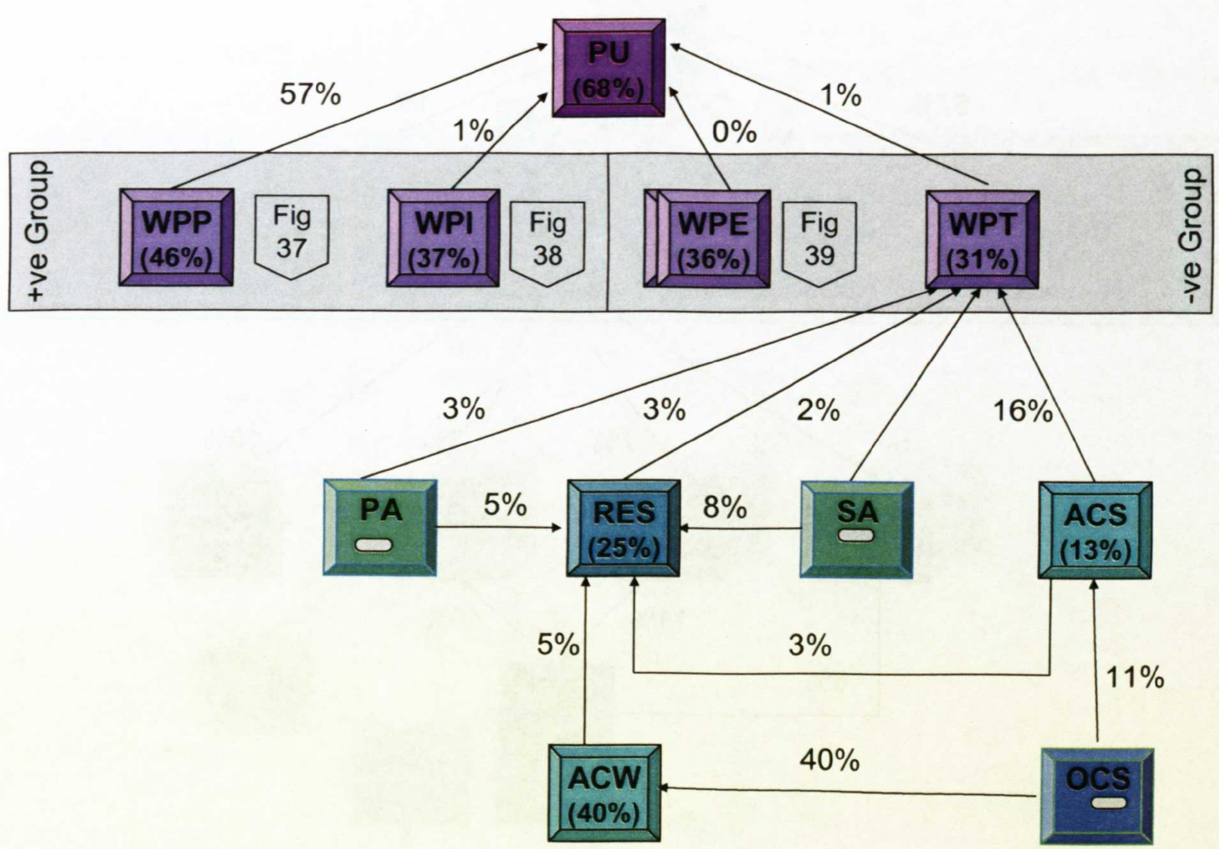


Figure 40: Factors Influencing Compatibility with Prior Experience with Technology



10.3.1. Factors Explaining Variances in Compatibility with Preferred Practices

As reflected in Figure 37. 46% of the total variance in Compatibility with Preferred Practices is explained by the model. The following variables account for this explained variance:

- Source Credibility – 27%
- Resistance – 7%
- Unproven Knowledge – 6%
- System Adaptation – 3%

10.3.1.1. Source Credibility

Source Credibility is positively related to Compatibility with Preferred Practices, and explains 27% of the variance in this dimension. SC also has a positive correlation with Compatibility with Imposed Practices, but explains less than 1% of the variance in the latter. There is a positive but insignificant correlation between this variable and Compatibility with Past Experiences with Technology, therefore increasing SC will not negatively influence Perceived Usefulness through prior experience perceptions. There is also a positive correlation between SC and Compatibility with Existing Practices, with the former explaining 5% of the variance in the latter. Although Compatibility with Existing Practices was found to reduce Perceived Usefulness, and therefore all variables increasing this factor should be controlled for, the substantial effect that it has on Compatibility with Preferred Practices should negate any adverse effects that it may have on success through Compatibility with Existing Practices.

The model explains 8% of the variance in SC, which is fully accounted for by OCS. OCS is an exogenous variable, and being a user trait, is outside of the control of the implementation team. To enhance ERP success through SC then, it is necessary to ensure that ERP vendors and members of the implementation team are perceived as reliable, trustworthy or knowledgeable by the users. As proposed above, this could be achieved by including functional area specialists with prior industry knowledge into the implementation teams. In this way, high levels of OCS will also be accommodated. This should help reduce perceptions of "outsiders" by users with a strong sense of commitment to their community of practice and encourage users to accept the new knowledge and working practices being offered.

10.3.1.2. Resistance

Resistance explains 7% of the variance in Compatibility with Preferred Practices, 3% of the variance in Compatibility with Imposed Practices, 3% of the variance in Compatibility with Past Experiences with Technology and less than 1% of the variance in Compatibility with Existing Practices. It is therefore included in the proposed framework due to its relatively substantial effect on Compatibility with Preferred Practices

The total variance in Resistance explained by the model is 25%. System Adaptation accounts for 8%, Process Adaptation accounts for 5%, ACW contributes 5% and ACS another 3%. System adaptation is discussed in section 10.3.1.4. Like System Adaptation, Process Adaptation has a positive correlation with Resistance. As discussed in Section 10.2.4, this may be due to a perception prior to actual use of the system. It is therefore suggested that to reduce resistance, efforts should be made by the implementation team to demonstrate to the users how the changes will enhance compatibility of the system to preferred work practices.

As noted in section 4.3.2.1, ACS and ACW are user characteristics and therefore outside of the control of the implementation team. Additionally, the variances in both ACS and ACW are fully accounted for by OCS (see 10.2.4), which is another user characteristic No suggestions on how to influence these variables can therefore be provided.

10.3.1.3. Unproven Knowledge

Unproven knowledge accounts for 6% of the variance in Compatibility with Preferred Practices. Although the correlation between this variable and Compatibility with Existing Practices is positive, the relationship is insignificant. UK also explains 1% of the variance in Compatibility with Imposed Practices and less than 1% of the variance in Compatibility with Past Experiences with Technology. It is therefore included in the proposed relationship model due to its relatively substantial effect on Compatibility with Preferred Practices.

The model explains only 5% of the total variance in UK, which is fully accounted for by OCS. As discussed in section 4.3.2.3, perceptions of unproven knowledge can be reduced by providing users with referrals from other members of their community in other organisations about the acceptability and usefulness of the system. This strategy of providing proof from referent communities of practice will also take into account the influence of OCS on this variable.

10.3.1.4. System Adaptation

System adaptation explains 3% of the variance in both Compatibility with Imposed Practices and Compatibility with Preferred Practices, providing a positive correlation with Perceived Usefulness. However, it also explains 10% of the variance in perceptions of compatibility with existing work practices, suggesting that system adaptation efforts are currently focused on adapting the system to be compatible with existing practices rather than preferred practices. In addition, SA is positively correlated with Resistance, accounting for 8% of the variance in the latter (see 10.3.1.2). As a result, SA also has a negative correlation with Perceived Usefulness.

SA is an exogenous variable in the model and therefore does not have any antecedents. In order to positively influence ERP success therefore, system adaptation should in future focus on making the system compatible with preferred working practices in favour of existing working practices. By refocusing the adaptation efforts in this way, it is possible that the effects on resistance will also be lowered. Therefore, system adaptation, focused on

Compatibility with Preferred Practices, is included in the set of relationships in the Positive Group.

10.4. Summary

The findings reported in the previous chapter were interpreted in two ways. Firstly, answers to the research questions identified in Chapter 5 were provided. Overall, and contrary to expectations, OCS did not appear to play a significant explanatory role in variances in ERP success, either directly, or through the other hypothesized variables. However, the data did support some of the hypothesized mediated relationships between occupational strength of commitment and ERP success. These mediated relationships were summarised into research sub-questions and decomposed into hypotheses in Chapter 5. Table 50 provides a summary of these sub-questions, and the respective answers as interpreted from the findings.

Where possible, explanations were offered for unexpected results, with further research being suggested as a way of testing the validity of these explanations.

Table 51: Answers to Research Questions

Research Question	Results	
	Expected	Unexpected
What is the relationship between Work Practice Compatibility and self-perceived individual performance?	↑WPI → ↑PU ↑WPP → ↑PU	↑WPT → ↓PU ↑WPE → ↓PU
What is the relationship between adaptation, knowledge transfer barriers and Work Practice Compatibility?		
What is the relationship between Adaptation and Work Practice Compatibility?	↑SA → ↑WPE ↑SA → ↑WPI ↑SA → ↑WPP ↑PA → ↓WPE ↑PA → ↓WPT	↑SA → ↓WPT ↑PA → ↑WPP PA → WPI – ns correlation
What is the relationship between Adaptation and Knowledge Transfer Barriers?	↑PA → ↑RES	↑SA → ↑RES
What is the relationship between Barriers and Work Practice Compatibility?	↑ACW → ↓WPE ↓AR → ↑WPE ↓AR → ↑WPI ↓AR → ↑WPT ↓RES → ↑WPE ↓RES → ↑WPI ↓RES → ↑WPP ↓RES → ↑WPT ↑SC → ↑WPE ↑SC → ↑WPI ↑SC → ↑WPP ↓UK → ↑WPI ↓UK → ↑WPP ↓UK → ↑WPTP	↑ACS → ↑WPE ↑ACS → ↑WPI ACS → WPP – ns correlation ↑ACS → ↑WPT ↑ACW → ↑WPP ACW → WPI – ns correlation ACW → WPT – ns correlation ↓AR → ↓WPP SC → WPP – ns correlation UK → WPE – ns correlation
What are the inter-relationships between the barriers?	↓AR → ↓RES	↓UK → ↑RES ↑SC → ↑RES ↑ACW → ↓RES ↑ACW → ↓RES
What is the relationship between OCS and knowledge transfer barriers?	↑OCS → ↑RES ↑OCS → ↑ACS ↑OCS → ↑ACW	↑OCS → ↓AR ↑OCS → ↑SC ↑OCS → ↓UK

Secondly, a framework for understanding and influencing ERP success was developed based on the results of the data analysis. The findings led to the conclusion that Compatibility to Preferred Practices played a significant role in ERP success, and therefore this factor, and its antecedents, formed the basis of the framework. However, it was deemed equally important to include in the framework those variables that were shown to have a negative influence on ERP success. Consequently, the framework was divided into two groups: Group 1 incorporates Compatibility with Preferred Practices and Compatibility with Imposed Practices, both of which were shown to positively influence Perceived Usefulness. All the variables that were empirically demonstrated by this research to explain the variances in these variables were incorporated into this group. Group 2 incorporates Compatibility with Existing Practices and Compatibility with Past Experiences with Technology, which were shown to negatively influence Perceived Usefulness. All the variables that were empirically demonstrated to explain variances in these variables were incorporated into this second group. Finally, given the significant explanatory power of Compatibility to Preferred Practices on Perceived Usefulness, the factors explaining the variances in Compatibility to Preferred Practices were discussed in detail.

CHAPTER 11

CONCLUSIONS

> "It just shows what can be done by taking a little trouble," said Eeyore. "Do you see, Pooh? Do you see, Piglet? Brains first and then Hard Work."
>
> Winnie the Pooh - The House at Pooh Corner

11.1. Introduction

The objective of this research was to investigate the relationship between Occupational Community of Practice Strength of Commitment and Perceived Usefulness of ERP systems, as mediated by the barriers to the knowledge transfer process, adaptation and perceptions of work practice compatibility. This objective arose as a result of the problem identified for this research, which was that ERP systems ought to be compatible with Occupational Communities of Practice work practices in order to achieve the expected benefits of improved job performance.

A survey instrument that was designed to measure the relationships between these variables was administered. The results led to the conclusions that Occupational Strength of Commitment had little effect on Work Practice Compatibility, but that Compatibility with Preferred Practices had a significant effect on Perceived Usefulness. It therefore became evident that in order to enhance ERP success, it was necessary to identify the variables that influence perceptions of Compatibility with Preferred Practices so that these variables can be focused on when implementing ERP systems. These variables were then synthesized into a conceptual model of ERP success in order to meet the research objective.

This chapter begins with a summary of the work completed (section 11.2). Contributions to the existing body of knowledge are then identified (section 11.3). Limitations and future research resulting from this research are reflected upon and discussed in section 11.4. Section 11.5 completes this chapter and this thesis with some final concluding thoughts.

11.2. Summary of Work Completed

This research began by reviewing the existing body of knowledge surrounding enterprise resource planning systems (Chapter 2). An overview of ERP systems, comprising the history, definitions and types of systems, the implementation approaches, operational approaches and alternative life cycles, was presented. The expected benefits of adopting an ERP system were then reviewed, leading to a discussion of the system characteristics of Best Practice processes, business process re-engineering and mandatory use, that are necessary to achieve these benefits. A review of the critical success factors followed, concluding with an analysis of the current failure rates and costs attached to those failures. It was posited that a possible reason for the continued high failure rate is the Best practice characteristic of ERP systems: because the Best practice processes are generic in nature, misfits between the organisational requirements and the system's functionality occur, resulting in misfits between the functionality provided by the system and the functionality required by the organisation.

Attention was then turned to the concept of ERP success (Chapter 3). Reviewing the IS and Usability literatures, it was argued that ERP success should ideally be measured in terms of the benefits that accrue as a result of using the system. However, as benefits are difficult to measure and error-prone, a proxy is required. The traditional proxies of system usage and user satisfaction were shown to be inadequate; instead, the appropriateness of quality in use, measured in terms of user task performance, was argued to be an appropriate proxy for measuring ERP success. Further, it was argued that the users' ability to perform their tasks effectively, efficiently and with satisfaction is dependent on the ability of the system to meet the users' stated and implied needs. This led to the conclusion that the multidimensional construct of Work Practice Compatibility is the primary critical success factor for enhancing task performance (quality in use).

The factors influencing Work Practice Compatibility within the ERP context were reviewed next (Chapter 4). Three sets of factors were identified, namely

(1) Adaptation, (2) Barriers to the knowledge transfer process, and (3) Occupational strength of commitment.

- Adaptation – it was shown that in order to enhance Work Practice Compatibility when implementing an ERP system, it is necessary to adapt either the system to suit the needs of the users, or the users' existing practices to suit the business model embedded within the system. Various levels of system adaptation were reviewed, together with the difficulties surrounding both system adaptation and existing practice adaptation
- Barriers to knowledge transfer – numerous barriers to effective knowledge transfer were reviewed. Six barriers were identified for inclusion into the research model, as they were shown to be the most relevant within the ERP context and most applicable to the implementation phase of ERP system adoption.
- Occupational strength of commitment – the literature on communities of practice and specifically occupational communities of practice was reviewed. The literature review identified three characteristics of community of practice members that could negatively affect the knowledge transfer process. In addition, it was shown that these characteristics are enhanced by a strong sense of commitment to the community. It was argued that users of ERP systems who have a strong sense of commitment to their occupations display these characteristics, suggesting that occupational strength of commitment could have a detrimental effect on Work Practice Compatibility and the resultant overall success of the ERP implementation.

The different sections of the literature review were then synthesized into a set of propositions that was used to develop a problem statement, a set of hypotheses, and a conceptual model for this research (Chapter 5). The research design, data collection and analysis methods, and ethical considerations relevant to this study were then presented (Chapter 6). A review of the alternative research approaches and designs was presented, leading to the conclusion that a Relativist approach, in conjunction with a quantitative strategy and a survey research design was most appropriate for this study. A questionnaire was the selected data collection method, with factor analysis and PLS-SEM selected for data analysis. Guidelines for the development of a survey instrument were also presented. The chapter concluded with a discussion of how each of the constructs included in the research model was operationalised, which made up the survey instrument developed specifically for this research.

A pilot study to test the research model and the survey instrument was then conducted, which resulted in a refinement of both the research model and the survey instrument (Chapters 7 and 8). Thereafter, the main study was administered and the data was analysed using PLS-SEM (Chapter 9).

Finally, the results of the main study were interpreted in two distinct ways (Chapter 10). Firstly, the results were interpreted within the framework of the research questions set out in section 5.5, with each question being answered in turn. Secondly, a framework for understanding and influencing ERP success was developed based on the results of the data analysis. The findings led to the conclusion that compatibility with preferred practices plays a significant role in ERP success, and therefore this factor, and its antecedents formed the basis of the framework. The framework was divided into two groups: Group 1 incorporates Compatibility with Preferred Practices and Compatibility with Imposed Practices, both of which were shown to positively influence Perceived Usefulness. All the variables that have been empirically demonstrated by this research to explain the variances in these variables are incorporated into this group. Group 2 incorporates Compatibility with Existing Practices and Compatibility with Past Experiences with Technology, which were shown to negatively influence Perceived Usefulness. All the variables that have been empirically demonstrated to explain variances in these variables are incorporated into this second group.

11.3. Contribution to Knowledge

The products of a successful dissertation must make a contribution to the existing body of knowledge surrounding an important problem (Blaxter et al., 2006). The importance and timeliness of the problem of ERP implementation success was established in Chapter 2.

11.3.1. Contribution to Research

The results of this research support and extend what is known about ERP system implementation. First, the identified but unsolved problem of the continued high failure rate of ERP implementations was highlighted. The problem was discussed from the socio-technical perspective that such systems should be compatible with users and their tasks, within the context of their occupational communities of practice. This discussion contributes to research by providing a detailed problem statement.

Secondly, in response to the call for integrating multiple categories of success factors into a single research study (Huang, 2010), a multidisciplinary view of the research problem was taken, and literatures from several disciplines, including occupational communities of practice, enterprise resource planning systems, information systems success, the knowledge transfer process, and human computer interaction, were investigated and synthesized. This contributes to research by providing a more comprehensive understanding of the problem domain, as well as an integrated set of propositions that could help to explain successful ERP adoption outcomes.

Thirdly, the literature surrounding the concept of information systems success, and in particular, ERP system success, was reviewed and consolidated, leading to the conclusions that (1) the traditional measures of User Satisfaction or System Use are inappropriate, and (2) Perceived Usefulness is an appropriate proxy for measuring ERP success. This contributes to the debate surrounding the appropriateness of measures for ERP and other information systems success.

Fourthly, a survey instrument was designed to test the relationships between the variables in the research model. After pilot testing and revision, the analysis of the data collected from the main study confirms that the instrument reflects discriminant and convergent validity, as well as internal validity and face validity. The instrument therefore contributes to the existing body of knowledge as it can be used for future similar studies.

Fifthly, Work Practice Compatibility was identified as a multi-dimensional construct consisting of the four dimensions of Compatibility with Existing Practices, Compatibility with Preferred Practices, Compatibility with Past Experiences with Technology and Compatibility with Imposed Practices, incorporating both stated and implied needs. Based on the results of the data analysis, it was demonstrated that the sub-dimensions of Work Practice Compatibility and Perceived Usefulness should be viewed as separate and distinct constructs, rather than as a single complex construct. The results further indicated that Compatibility to Preferred Practices is an important antecedent to Perceived Usefulness. This contributes to the debate surrounding the antecedents of success.

Finally, a framework for understanding and influencing ERP success was developed based on the results of the data analysis. The major contributions of this thesis stem from this proposed framework discussed in Chapter 10. This is unique and significant, and is seen to be useful to both academics and practitioners interested in enhancing the success of ERP adoption outcomes. From an academic perspective, the framework provides a more holistic view of the issues that influence ERP success, which can serve to better focus future research efforts. In addition, the framework can also be used as a basis for structuring tertiary coursework related to ERP studies (for example C. J. Stefanou & Bialas, 2009; Venkatesh, 2008).

11.3.2. Contribution to Practice

The results of this research provide several practical implications for management and consultants participating in the ERP system experience.

Previous research has conceptualised information systems success, and thus ERP systems success, in terms of user satisfaction or system use. However, it was shown that these traditional measures are unsuitable. Perceived usefulness is a more appropriate measure for ERP success at both end-user and organisational levels. This is because perceived usefulness is measured in terms of enhanced task performance: the ability of the system to meet the needs of the users and enable them to complete their tasks effectively, efficiently and with satisfaction. Enhanced task performance results in reduced costs and increased profits, which are the primary benefits expected from the adoption of ERP technologies. During the implementation process, therefore, management and consultants should pay careful attention to the needs of the intended users. Ensuring that the system will meet user needs and focusing on the factors that influence user perceptions of usefulness will enhance these beliefs.

Beliefs about the compatibility of the system with users' working practices appear to play a significant role in the shaping of users' perceptions of the usefulness of the system. The results show that positive beliefs about system compatibility with users' preferred work practices have a substantial and positive effect on users' perceptions of the ability of the system to meet their needs and enhance their work performance. In addition, positive beliefs about system compatibility with users' imposed practices have a small and positive effect on perceptions of usefulness. In contrast, beliefs that the system is compatible with existing practices and prior technical knowledge have negative effects on perceptions of usefulness. Therefore, during the implementation process, efforts should be focused on

- developing the positive beliefs about compatibility with preferred and imposed working practices – this can be achieved in many ways, for example, by highlighting the similarities between work practices enabled by the technology and the user's preferred work practices, by emphasizing how the technology meets imposed work practices, and where feasible, by adapting the system to meet these practices.

- underplaying the positive beliefs about compatibility with existing practices and prior experiences with technology - these compatibilities are still important for ease of use and should not be eliminated from the new system. However, they have negative effects on perceptions of usefulness and should therefore not become a focal point during the implementation process.

Since compatibility with preferred work practices beliefs play a significant role in shaping beliefs about usefulness, managers and consultants responsible for the implementation of ERP technologies should pay careful attention to their antecedents. Several barriers to the effective transfer of knowledge between the intended users of the system and the implementation team were identified as having significant effects on end-users' beliefs about compatibility with preferred work practices. Based on the results of this research, the following advice can be proposed regarding these barriers:

- ERP vendors and members of the implementation team should appear reliable, trustworthy and knowledgeable to end-users. This could be achieved by including functional specialists with prior industry knowledge into the implementation team.

- The implementation team can help to reduce user resistance by demonstrating how the new system, or changes to existing work practices, will help them to achieve their preferred ways of working

- Perceptions of unproven knowledge can be reduced by providing users with testimonials from other members of their occupational community of practice employed within other organisations about the acceptability and usefulness of the system.

The above discussion can be viewed as a cost–effective and focused framework which provides management and consultants with a better understanding of the critical success factors that should be incorporated into ERP implementation initiatives from an end-user perspective. It has been shown that of the four dimensions of Work Practice Compatibility, Compatibility with Preferred Work Practices is the only dimension that has a significant and sizeable effect on success, thereby reducing the need to accommodate the other three dimensions. In addition, it is only necessary to incorporate into the implementation phase those variables that have been shown to influence

Compatibility with Preferred Work Practices. In this way, the complexity and cost of future ERP implementation initiatives can be reduced

11.4. Limitations and Future Research

Due to the complexity of the problem, there is a vast amount of work that must be done before ERP success can be fully understood. These additional efforts are outlined here and left as future research.

There are two categories of future work: (1) issues that arose as a result of limitations of the study, and (2) issues that arose as a result of the analysis and interpretation of the data collected for this study. These are discussed below.

11.4.1. Domain and Methodology Limitations

This research focused on the factors that influence ERP success from an end-user perspective. For parsimonious reasons, only a subset of these factors was included into the research model. Consequently, the results do not reflect all possible factors relating to end-user perspectives, nor the factors that influence ERP success from other stakeholder perspectives. Thus, further research is required to provide a fuller understanding of all the factors that influence different stakeholder perspectives, and their interrelationships.

A second potential limitation of this research is the self-report bias found in survey research. This occurs when respondents misreport their perceptions. There us no way to determine if this was done in this study, but the potential of this occurring must be considered. According to Wright (2005), the best defence against deception is replication. Therefore, future research could conduct similar online surveys with the same or similar types of respondents to determine the reliability of the results.

Thirdly, the use of the Internet to collect data may be a limitation of this study. Collecting data through the Internet has been established as a valid method of collecting survey data ((Schmidt, 1997). However, this method is not without limitations, such as the self-report bias and deception already discussed above (Wright, 2005). Additional limitations specific to this method include self-selection bias (Wright, 2005) and the inclusion of invalid respondents (Schmidt, 1997). Self-selection bias occurs as a result of some individuals in a particular online community being more predisposed to completing online surveys than others, thus leading to a sampling bias. Although the prescribed precautions were taken (as discussed in sections 6.4 and 6.8.6), it is acknowledged that the potential for inclusion of invalid respondents cannot be entirely eliminated. As a result, the generalisability of the results should be treated with caution.

Finally, the relatively small sample size adds some limitations to this research. Although the number of respondents met the minimum requirements for the selected quantitative data analysis method, it was not possible to partition the data to perform the detailed analyses originally intended, as discussed in section 6.2.1. Opportunities for future research therefore exist to investigate how factors such as

- membership of different occupational communities of practice
- the length of system use;
- the length of tenure;
- the length of time in a particular line of work; and
- different types of systems

affect the factors that have been shown to influence ERP success.

11.4.2. Validation of findings

Not all of the hypotheses were supported by the data, and in some cases, the data reflected results that were contradictory to the literature. In these cases, further research studies have been identified to confirm the results of this study, and/or to validate the explanations provided for the observed correlations. These are as follows:

- The relationship between Perceived Usefulness and Work Practice Compatibility – due to the inconsistencies between the study findings and the literature, further research into the relationship between Perceived Usefulness and Compatibility with Existing Practices, and the relationship between PU and Compatibility with Past Experiences with Technology are required before the findings and explanations provided can be accepted (see 10.2.2)

- The relationship between system adaptation and Compatibility with Past Experiences with Technology – further research is required to validate the explanation provided for the findings (10.2.3.1)
- Relationship between Arduousness of Relationship and Compatibility with Preferred Practices – no explanation could be found for the contradictory results obtained, and further research is recommended to determine whether similar results are obtained from studies in similar contexts (10.2.3.3)
- Interrelationships between barriers – no explanation could be found for the positive relationships between unproven knowledge and resistance, and source credibility and resistance. Further research is required to determine whether similar results will be obtained in different studies. In addition, the explanations provided for the unexpected negative correlations between resistance and absorptive capacity also require further research for validation purposes (10.2.3.4).
- Relationship between Occupational Strength of Commitment and Barriers to Knowledge Transfer – further research is identified to validate the explanations provided for the negative correlation between Occupational Strength of Commitment and Arduous Relationship, the positive correlation between Occupational Strength of Commitment and Source Credibility, and the negative correlation between Occupational Strength of Commitment and Unproven Knowledge (10.2.4).
- Additional correlations identified – further research is identified to determine the direction of the relationships as well as provide support for the suggested interpretations given for the additional correlations reflected in the inter-construct correlation matrix (10.2.5).

11.5. Conclusion

This chapter has summarised the work done for this thesis. Contributions to the existing body of knowledge have been identified, as well as areas for further research that resulted from this work.

In conclusion, whilst this research has contributed to a better understanding of the reasons for the high failure rates that are experienced with ERP implementation initiatives, it does not provide a complete solution, and also raises issues that require further research. ERP systems are complex, socio-technical systems that result in significant impacts on the organisation at the individual, work group, organisational and inter-organisational levels. Thus, it is not just the responsibility of IT professionals to understand how to prevent the failures (Sessions, 2009). Instead, a multidisciplinary approach should be taken, with representatives from the different organisational perspectives working together to address this problem.

APPENDIX 1: ETHICS APPROVAL

HUMAN PARTICIPANTS AND MATERIALS ETHICS COMMITTEE (HPMEC) PROFORMA

To apply for HPMEC review of your research ethics protocol, please complete and email this proforma to: Research-Rec-Review@open.ac.uk.

If you have any queries about completing the proforma please look at the Research Ethics website: www.open.ac.uk/research/ethics/, in particular the FAQs.

The submission deadline for HPMEC is **every Thursday** at **5.30pm** and applications will be assessed the next day. Once an application has been passed for review you should receive a response within 10 working days.

For all other general research ethics queries, please email Research-Ethics@open.ac.uk or
☎ **01908 654858**.

Project identification and rationale

Title of project

The extent to which occupational communities of practice strength of commitment explains variance in ERP success as measured in terms of work practice compatibility

Abstract

Organisations invest large amounts of money in enterprise resource planning (ERP) systems with the expectation that such systems will enable competitive advantage through efficiency, productivity and profitability. However, many companies continue to report that their ERP systems have fallen short of their expectations, resulting instead in increased user errors, customer frustration and ultimately a loss in profits.
One of the significant contributing factors to this poor success rate that continues to occur, despite the efforts of academics and practitioners, is the misfits that arise between user needs and the functionality required by the system. This research investigates a hitherto unexplored potential explanation for this phenomenon in terms of occupational communities of practice.

ERP system functionality is provided in terms of "Best practice" at the industry

level. In contrast, actual work practices are strongly influenced by occupational communities of practice, suggesting that misfits will arise. In addition, members of these communities display characteristics that could strengthen barriers to knowledge transfer.
Using a quantitative approach, this study investigates the extent to which membership of occupational communities of practice, and the strength of commitment to such communities, affects the transfer of knowledge and adaptation processes during system implementation, and the direct and indirect effects on the resultant work practice compatibility and consequences of system use.

Project personnel and collaborators

Investigators

Give names and institutional attachments of all persons involved in the collection and handling of individual data. Name one person as Principal Investigator (PI). Research students should ask their primary supervisor to endorse their application by email to Research-Rec-Review@open.ac.uk, quoting the HPMEC reference number assigned to them. Research students should normally name themselves as Principal Investigator.

Principal Investigator/ (or Research Student):	Gabrielle Ford
Other researcher(s):	
Primary Supervisor (if applicable)	Dr S.E. Little

Research protocol

Literature review

Organisations adopt ERP systems because of the benefits expected to be derived from their use. Use does not necessarily produce benefits: use generates impacts, and impacts can be perceived as positive or negative. The critical issue for success then is not whether the system is used, but rather that benefits should arise from such use. Whilst system use must necessarily precede benefits realisation, it is the quality of such use (N.. Bevan, 1995; Boudreau, 2002) that influences the degree to which benefits are achieved.
Quality in use is the extent to which a product used by specified users meets their needs to achieve specified goals with effectiveness, productivity and

satisfaction in a specified context of use (Bevan, 1995). This demonstrates that quality in use is more than just knowing which functions to use and when: it is the effect of the technology in terms of the outcomes that result from use and thus relates more broadly to the extent to which the software meets the needs of the users (Affleck & Clark, 2008; N. Bevan & MacLeod, 1994; Dix et al., 2004). This view is supported by Moore & Benbasat (1991) who note that "an innovation cannot be viewed as advantageous if it does not meet users' needs".

Meeting user needs can be viewed as the fit between the user, the task and the technology (Goodhue & Thompson, 1995), that is, the extent to which the system provides the functionality required by the users to effectively perform their tasks.

Compatibility is defined by Rogers (1983, 1995) as the degree to which using an innovation (technology) is perceived as consistent with the existing socio-cultural values and beliefs, past and present experiences, and needs of potential adopters (Rogers, 1983; p. 223). Thus, compatibility with work practices can be seen as synonymous with meeting user needs.

Organisations employ staff that belongs to several Occupational Communities of Practice (OCoP), for example, employees within the accounting and finance department may belong to the Institute of Chartered Accountants, or employees within the sales and marketing function may be members of the Chartered Institute of Marketing. The working practices of the members of these OCoPs are shaped, to a large extent, by the rules and policies that govern the community, and also influenced by the training, organisational experience and apprenticeship programme that members undergo in order to become fully fledged and capable members of the community (Trice, 1993)

Thus it can be argued that meeting user needs refers to the extent to which the system is compatible with the established work practices of its users and their referent occupational communities of practices; or, put another way, that meeting user needs refers to the level of work practice compatibility that the system offers.

Prior research has reported, however, that it is common for gaps to arise between the functionality provided by an ERP system and the functionality required by the users (e.g. Sia & Soh, 2007). These misfits occur because organisations and users have unique business requirements whereas ERP systems are designed to provide a generic solution in the form of "Best practice" at the industry level. These misfits lead to reduced benefits realisation, thus resulting in lowered ERP success rates.

To enhance Work Practice Compatibility when implementing an ERP system, it is necessary to adapt either the system to suit the needs of the users, or the users' existing practices to suit the business model embedded in the system (Hong & Kim, 2002). Such adaptation requires a bi-directional transfer of knowledge between the source (ERP implementation team) and the recipient (the intended users). This transfer of knowledge occurs mainly during the implementation phase of the knowledge transfer process. Transfer of knowledge is a difficult process with many known barriers (Szulanski, 2000). These barriers relate to the characteristics of the source, the recipient, and the transfer environment

In general, OCoPs display specific characteristics that are enhanced by a strong sense of commitment to the community. These characteristics could adversely effect the knowledge transfer process, which, in turn, could affect the adaptation process required to enhance the fit between the users' work practices and the work practices embedded within the system.

Consequently, it is posited that OCoP strength of commitment negatively affects the levels of work practice compatibility achieved with the adoption of an ERP system, through its effects on the barriers to the knowledge transfer process. This view has to date not yet been investigated in prior research studies.

Methodology

Data will be collected electronically via SurveyMonkey.com, and will entail collecting data about ERP users':

- strength of commitment to their chosen occupation
- perceptions of the implementation team / consultants and the system during implementation
- their perceptions of the extent to which the system or their work process were adapted during implementation
- perceptions of the extent to which the system now meets their job needs
- perceptions of the outcome of the implementation, in terms of how the use of the system has affected their job performance.

Participants

Participants required for this study are end users of ERP systems. Participants will be sourced from multiple companies to ensure sufficient representation of occupational communities of practice. Members and non-members of occupational communities of practice will be sourced so that comparisons can be drawn between the different groups. To control for the potential effects of general user differences, participants will be sourced from diverse nationalities, educational and experiential backgrounds

Recruitment procedures

Access to a sample population has been arranged through collaboration with an ERP consulting company in the USA, who have agreed to provide access to their clients. This will be done by providing a link to the survey via their website.

Additional access in the form of permission to send a global email, containing a brief description of the research and a link to the survey, to the member distribution list of the following organisations is currently being negotiated:

(a) The APICS organisation – Canada

(b) The APICS organisation – USA

(c) Online communities

Consent

On the first page of the survey, respondents will be advised of the purpose of the research study and will be asked to confirm their consent by clicking on the appropriate consent box (See Appendix 1)
As explained in Appendix 1, the survey responses are completely anonymous and therefore individual responses cannot be identified. As such, all responses will be included in the final data set.

Location(s) of data collection

Data will be collected through the administration of a survey questionnaire, hosted by SurveyMonkey.com. .
It is anticipated that data collection will take place during November 2010.

Schedule

Research commenced 1 October 2008. Final thesis submission is scheduled for 30 September 2011.
Data Collection is planned for November 2010
Analysis of data is planned during the period December 2010 – February 20100, with write-up occurring concurrently until the end of September 2011.

Key Ethics considerations

Published ethics and legal guidelines to be followed

BSA

Data Protection

The data stored on the SurveyMonkey database is SSL protected. The data will then be downloaded to Microsoft Excel for initial cleanup before being imported into AMOS for further analysis. All electronic documents will be password-protected with only the PI knowing the password. Each participant is allocated a non-identifiable reference number by SurveyMonkey, which cannot be used to trace their identity.
All backups will be burned to CD and stored in a locked filing cabinet, together with any printed versions of the electronic document and notes. Any hardcopies no longer required will be shredded.

Recompense to participants

None

Deception

No deception is required for this study

Risk of harm to participants

None

Debriefing

The findings of this research project will be communicated back to the collaboration company as per the original agreement.
If this research is published to a wider audience I will inform the participants about this, so they can read the article should they wish to.

Project Management

Research organisation and Funding

Please provide details of the principal funding body. If your project is externally funded enter your RED Form reference number below. For further guidance contact your Faculty Research Administrator (FRA) or refer to the Research Grants and Contracts website.

Red Form Ref No.:

Other project-related risks

Risks in terms of obtaining a statistically sufficient number of respondents has been limited by identifying alternative access paths to relevant sample populations which are currently being negotiated.

Benefits and knowledge transfer

Due to their significant cost implications and extensive organisational impacts, ERP system success has received a great deal of attention across several disciplines. However, almost 75% of companies are still reporting that their ERP systems have fallen short of their expectations, with negative outcomes resulting ultimately in a loss in profits. To date, the reasons for this high failure rate are still unclear and are being examined.
Investigating the problem of ERP success through the lens of occupational communities of practice could reveal a previously unidentified, and significant, explanatory factor of ERP adoption outcomes. Thus, the findings of this research study could help to enhance the potential for ERP success.

Declaration

I declare that the research will conform to the above protocol and that any significant changes or new ethics issues will be raised with the HPMEC before they are implemented.

Name:	**Gabrielle Ford**
Unit/Faculty:	**OUBS**
Telephone:	**01908 653274**
email:	**g.ford@open.ac.uk**
Date:	**27 October 2010**

Once your research has been completed you will need to submit a HPMEC final report. You will be prompted for this by HPMEC on the date you enter below.

Proposed date for final report: 30 September 2011

APPENDIX 2: APPEAL FOR RESPONDENTS

Dear ERP User

Thank you for your interest in this PhD research study. With your help I hope to gain valuable insights into how well computerised systems, such as the one your company has recently implemented, meets the needs of the people that actually use those systems on a day to day basis.

The quality of your answers will largely determine the usefulness of our study and for the software development industry as a whole. Thus, the quality of your input is vital. Please share with me your insights and understanding on the different aspects that I think may be contributing to the ability of the system to meet your job needs.

Before continuing onto the survey itself, it is important that you understand the following:

(1) Confidentiality
You may be assured of complete confidentiality. As you progress through the questionnaire, you will notice that I do not request any personal information from you. You will be identified only by a random number allocated by SurveyMonkey.com, (the Internet based company that is providing the tool through which you can access this survey). Your responses will be coded by me personally, and all statistical analyses will be at a level of aggregation that will completely prevent identification at an individual level.

(2) Withdrawal
Please note that once you have submitted, it will not be possible to identify your individual responses and therefore your responses will remain part of the final dataset. However, you can exit the survey before completion at any time by clicking on the "Exit this survey" link on the top right hand corner of each page. It should take no more than 20 minutes to complete, so I would really appreciate it if you would complete it in its entirety.

(3) Use of Data and Data Protection
The information you provide with be confidential and used only for the purpose of this PhD research study. All information you provide is protected in compliance with the Data Protection Act, the Open University Ethics Principles for Research involving Human Participants (www.open.ac.uk/research/research-school/resources/research_information_and_communications.php) and the Market Research Society's Code of Conduct (www.mrs.org.uk).

Please select the "I wish to participate" button below if you have understood the information provided and you are willing to participate in this research
O Yes, I wish to participate in this research

Thank you.
Gabrielle Ford

APPENDIX 3: REVISED FACTOR ANALYSIS

REVISED FACTOR ANALYSIS WITH AR2 OMITTED

Run MATRIX procedure: PARALLEL ANALYSIS: Principal Components

Specifications for this Run:
Ncases 312
Nvars 48
Ndatsets 1000
Percent 95

Random Data Eigenvalues

Root	Means	Prcntyle
1.000000	1.849790	1.943233
2.000000	1.761996	1.829796
3.000000	1.694371	1.747694
4.000000	1.636312	1.684624
5.000000	1.584760	1.631456
6.000000	1.537839	1.581245
7.000000	1.496574	1.536016
8.000000	**1.454901**	1.492891
9.000000	**1.415831**	1.451550
10.000000	1.378561	1.413245

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.831	24.648	24.648	11.831	24.648	24.648	6.745	14.053	14.053
2	4.122	8.587	33.235	4.122	8.587	33.235	4.447	9.264	23.317
3	4.051	8.441	41.675	4.051	8.441	41.675	4.233	8.819	32.135
4	2.993	6.236	47.911	2.993	6.236	47.911	3.790	7.895	40.030
5	2.246	4.679	52.590	2.246	4.679	52.590	3.388	7.059	47.089
6	2.117	4.411	57.000	2.117	4.411	57.000	2.316	4.825	51.914
7	1.632	3.401	60.401	1.632	3.401	60.401	2.291	4.772	56.687
8	1.552	3.233	63.635	1.552	3.233	63.635	2.095	4.364	61.050
9	1.341	2.793	66.428	1.341	2.793	66.428	1.849	3.852	64.903
10	1.188	2.476	68.904	1.188	2.476	68.904	1.517	3.161	68.064
11	1.137	2.369	71.272	1.137	2.369	71.272	1.381	2.877	70.941
12	1.012	2.109	73.382	1.012	2.109	73.382	1.172	2.441	73.382
14	.847	1.765	76.976						

Extraction Method: Principal Component Analysis.

Pattern Matrix[a]

	Factor							
	1	2	3	4	5	6	7	8
QIU5	.813	.027	.073	-.092	.097	-.003	-.027	.005
QIU1	.794	.060	.115	-.043	.053	.041	-.010	-.075
QIU4	.750	-.052	.030	-.140	-.002	.098	-.036	-.083
QIU3	.725	-.006	.035	-.159	.025	.055	-.062	.019
QIU2	.673	.030	.046	-.118	.074	.138	.021	-.090
WPP3	.563	-.011	.094	-.025	.119	.078	-.246	.010
WPO3	.562	-.083	.030	-.118	.021	.090	-.250	-.063
WPP2	.524	.058	.051	.049	.099	.130	-.279	.048
QIU6	-.343	-.094	.248	-.120	-.026	-.005	-.002	.061
SA6	-.092	.871	-.039	.031	.128	.079	-.007	-.054
SA5	-.077	.858	-.088	-.004	.075	.053	.010	-.121
SA9	.090	.610	.020	-.140	-.053	-.013	-.010	.007
SA8	.146	.564	.160	-.182	.058	.064	.154	.171
SA7	-.073	.489	.121	-.185	.053	.193	-.019	.092
OCS3	.107	-.029	.877	.045	.014	.105	.039	.015
OCS4	.106	-.013	.861	.012	.003	.012	-.030	-.001
OCS6	.024	.010	.808	.014	-.078	.061	-.068	-.123

OCS5	-.038	-.037	.746	-.054	.041	.104	-.007	-.173
OCS2	-.112	.090	.736	.043	.030	.058	-.034	-.042
OCS1	.171	.090	.308	.033	-.026	-.263	.076	-.053
PA8	.049	.198	.032	-.833	-.045	-.094	.049	-.056
PA9	.151	.095	-.007	-.782	.010	-.111	.066	.005
PA7	-.068	.028	-.063	-.781	.026	.038	.020	-.104
PA5	.103	.027	-.029	-.752	-.140	.148	-.060	-.051
PA6	.154	.062	-.001	-.722	-.102	.110	-.065	-.048
WPE2	.006	.030	.024	.084	.905	.081	.016	-.043
WPE3	.047	.038	.063	.106	.887	.004	.039	.020
WPE4	.081	.164	-.282	.036	.424	-.040	-.073	-.059
SU5	.091	.054	.089	-.070	-.043	.726	-.156	.016
SU3	-.035	.066	.107	-.063	-.074	.715	-.165	-.098
SC4	.051	.121	.021	-.015	.141	.677	.061	.051
SC2	.171	-.010	-.035	.102	-.020	.676	.238	-.095
SC3	.119	.045	.083	-.047	.139	.652	.083	.012
SC1	.136	-.019	.048	.079	.103	.651	.078	-.155
AR1	.001	.187	.084	-.089	-.016	.539	-.099	.055
SU1	-.053	.253	-.026	-.090	-.041	.513	-.275	-.024
WP1	.128	-.148	.143	-.119	.230	.067	-.661	-.036
WPI5	.394	-.117	.112	-.065	.122	.110	-.543	.023
WP12	.053	-.105	.006	-.216	.108	.005	-.504	-.122
WP16	.399	-.054	.093	-.080	.159	-.020	-.475	.043
WPO2	-.088	-.100	.032	-.218	.112	.037	.469	.020
WPO4	-.184	-.185	.092	-.173	.092	-.041	.416	-.039
ACS1	-.113	.071	.207	.027	.081	-.008	-.244	-.705
ACS3	-.036	-.014	.127	-.112	.003	-.157	-.035	-.648
ACS2	.112	.057	.087	-.048	.133	-.162	-.160	-.529
UK1	.022	-.018	-.060	-.064	-.005	.087	.048	-.412
UK4	.106	.037	.036	.117	-.065	.113	.061	-.268
UK3	-.001	-.058	-.004	-.091	.046	.087	.074	-.229

Extraction Method: Principal Axis Factoring.

Rotation Method: Oblimin with Kaiser Normalization.

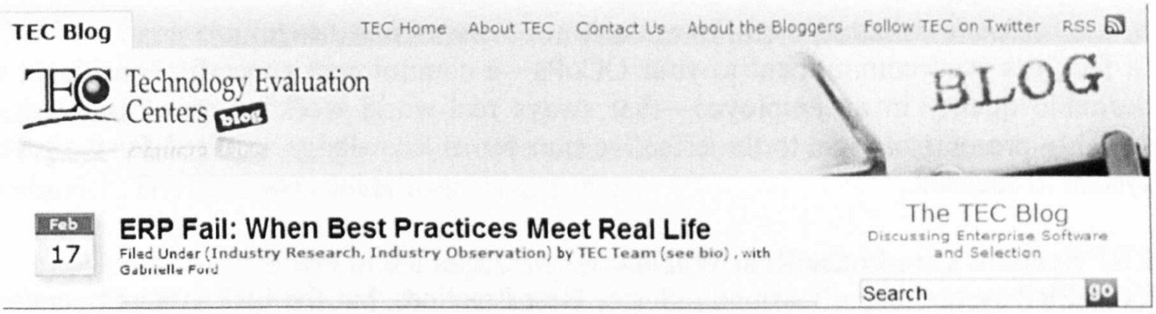
a. Rotation converged in 19 iterations.

Factor Correlation Matrix

Factor	QIU/ WPP/WPO 1	SA 2	OCS 3	PA 4	WPE 5	SU/SC/AR 6	WPI 7	ACS 8
1	1.000	.225	.167	.124	.250	.253	.351	.247
2	**.225**	1.000	.051	.145	.125	.270	.089	.003
3	.167	.051	1.000	.191	-.003	.079	.066	.250
4	.124	.145	.191	1.000	.068	.180	.036	.155
5	**.250**	.125	-.003	.068	1.000	.141	.129	.168
6	**.253**	**.270**	.079	.180	.141	1.000	.093	.183
7	**.351**	.089	.066	.036	.129	.093	1.000	.055
8	**.247**	.003	**.250**	.155	.168	.183	.055	1.000

Extraction Method: Principal Axis Factoring.

Rotation Method: Oblimin with Kaiser Normalization.



http://blog.technologyevaluation.com/blog/2011/02/17/erp-fail-when-best-practices-meet-real-life/

Open University PhD candidate Gabrielle Ford has a new perspective on why, despite an abundance of expert insight, so many ERP implementations continue to fail. TEC is collaborating with Ford to provide a 20-minute survey for ERP users, and is offering three-day free access to its evaluation models and vendor data to readers who complete the survey. Take the survey now. This post signals the start of several contributions from Ford regarding the relationship users have with their ERP systems.

Organisations adopt enterprise resource planning (ERP) systems because of the benefits they expect to derive from their use. The critical issue for success is not whether the system is used (because you aren't given a choice—you will use it), but rather that benefits arise from its use. While system use necessarily precedes full benefits realization (that's not to discount the potential benefits to be gleaned from the exercise of gathering requirements and defining processes prior to system selection and implementation), it is the quality of the use that influences the degree to which benefits are achieved.

Why Companies Still Aren't Happy

Almost 75% of companies report that their ERP systems have fallen short of their expectations, with negative outcomes, including problems of data inaccuracies, resistance by users, customer frustration, high staff turnover, and ultimately a loss in profits. To date, the reasons for this high failure rate are still unclear and are being examined.

But Gabrielle Ford, PhD candidate at the Open University, has a theory about what's contributing to these statistics. According to Ford, "The stronger the commitment of employees to their occupational communities of practice, the more likely your actual work practices won't be a great fit with your new ERP."

Is Employee Commitment a Barrier to ERP Success?

Occupational communities of practice (OCoPs) are the professional organisations you belong to. For example, employees within the accounting and finance department may belong to the Institute of Chartered Accountants, or employees within the sales and marketing function may be members of the Chartered Institute of Marketing. The working practices of the members of these OCoPs are shaped, to a large extent, by the rules and policies that govern the community, and also influenced by the training, organisational experience, and apprenticeship that members undergo in order to become fully fledged and capable members of the community.

Organisations employ staff that belong to several OCoPs. It's these OCoPs that shape the way companies do business.

In fact, it's your commitment to your OCoPs—a commitment generally considered a desirable quality in an employee—that sways real-world work practices, and quite possibly presents barriers to the effective transfer of knowledge required for the ERP system to succeed.

ERP Systems Live in the Real World

Your ERP system is built around industry Best Practices, but the ERP system operates in a real-world workplace. While Best practices are an ideal to which all enterprises aspire, real-world practices have evolved to suit the unique business requirements of the particular organisation you work for, shaped and informed by your OCoPs. So real-world practices aren't in perfect alignment with the best Practices embedded within the system design. Misfits happen.

When misfits occur, the system can't meet the needs of the users. In other words, compatibility is lost and therefore the quality in use is reduced. This causes user dissatisfaction, errors, workarounds, loss of productivity, the inability to realize expected benefits, and, ultimately, the perception that the system is a failure.

Is Compatibility a Pipe Dream?

Compatibility, the degree to which using an innovation (technology) is perceived as consistent with the existing sociocultural values and beliefs, past and present experiences, and needs of potential adopters, can be seen as synonymous with meeting user needs.

To enhance work practice compatibility when implementing an ERP system, you need to adapt either the system to suit the needs of the users, or the users' existing practices to suit the business model embedded in the system. That requires a bidirectional transfer of knowledge between the source (ERP implementation team) and the recipient (the intended users). This transfer of knowledge occurs mainly during the implementation phase of the knowledge transfer process, but often with great difficulty and many known barriers.

So how do you reconcile how you want, or need, to work with how you're now being forced to work?

Advocating User Needs

All of the critical success factors identified to date are focused on changing user behavior—essentially forcing the system onto the user—through such mechanisms as organisational change management, business process re-engineering, and assuring users that the system is really required.

Studies tend to focus on management: the impact of the system on company-level issues, such as return on investment (ROI), productivity, increased profits. Ford intends to change this. "The problems faced at the company level are simply a consolidation of the problems that occur at the level of the individual."

Ford wants to refocus the issue: what impact does the ERP system have on the performance and job satisfaction of the users? Implementation teams need to fully understand, acknowledge, and respond to user needs. By uncovering these factors, companies—and software developers—can begin to implement ERP systems in a way that better suit employees, and improve the chances of implementation success.

ERP Satisfaction: A Survey

Ford has devised a survey to uncover some key factors related to user needs and behavior. The questions cover basic issues like:

- Your involvement in the implementation of the computer system
- Your perceptions of the system implementation team and your relationship with them
- Your satisfaction with the current computer system

If you are a user of an ERP system, you are encouraged to participate—the survey takes only 20 minutes to complete, and the potential benefits are huge. Your responses will be completely anonymous.*

If you are an information technology (IT) manager or implementation consultant, please give your ERP users the opportunity to participate in this study. Please share the link to this survey.

TEC Advisor: Free Trial

TEC's online software evaluation and selection application, TEC Advisor, contains detailed information about enterprise software solutions—collected directly from vendors and validated by TEC analysts—and helps companies make rational, justifiable software selections more quickly and more cost-effectively than traditional methods. TEC is offering a free three-day trial of TEC Advisor to all participants who complete the survey for an evaluation of a software model and vendor of their choice. It's TEC's way of thanking readers for providing valuable information about their experience with an ERP system.

It's Sociotechnical

In Ford's view, management and ERP vendors are too focused on implementing technology that promises productivity and profits. They need to remember the workforce that comprises the actual users of that technology. People in a workplace are not just automatons performing a task—they have an identity, a past, and individual differences such as cultural values and past experiences, and they belong to communities of practice, all of which shape their identities and beliefs and values and ways of working.

Management needs to remember that an ERP system, like all technology, is a sociotechnical system: it shapes, and should be shaped by, its users.

Gabrielle Ford is a PhD candidate at the Open University (Milton Keynes, United Kingdom). She has worked as a business systems analyst and financial specialist, published on the principles and evaluation of accounting information systems, and *lectured on, among other subjects, human–computer interaction. In the coming months, she'll be reporting on the progress she's making with her research.*

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*No personal information will be collected. Data you provide will be treated as confidential and is protected in compliance with the *Data Protection Act*, the Open University Ethics Principles for Research Involving Human Participants, and the Market Research Society's Code of Conduct.

Share This Trackback Address
Tags: compatibility, employee commitment, ERP, implementation failure, implementation success, occupational community of practice, sociotechnical system, survey

Comments

Ray Talwar on 20 February, 2011 at 5:21 pm #

Bi-directional adaption is desirable. However, there is a cost to adapt the ERP software.

Who pays for this ? This is often the reason for cost overruns so common in ERP implementations.

users must be cognisant of the inertia to change and resist it. If their practices gives them unique competitive advantage, then it is worth the change the ERP system. However, the current practises may often be the legacy of past practices that must be abandoned for the industry Best Practices.

Fran Guerra on 20 February, 2011 at 8:03 pm #

Most enlightening.

Wayne M on 20 February, 2011 at 11:28 pm #

I have been in this business since the mid 70's and worked with hundreds of accounts across the globe and in most industries.

Many of the so called Best Practices are only best practives for a few if any. The people designing and creating these systems many times have very little real workd experience (1-2 companies over a few years). they take a system they wrote for someone else , slap some offshore green horns on it and call it Best Practices.

These systems are recommended because of the huge fees they drive for the partners of the CONsulting companies.

We worked with one 17 billion dollar client that had a Best Practices system from a large global CONsulting company. Their physical inventory took 8 people 4 days in 1 warehouse with 40 million in materials. We wrote a system that could do the physical with 2 people in 4 hours and then we pumped the data back into the system. This allowed them to do a physical weekly and cut shrink 90% from existing levels. I guarantee you the best practives CONsulting company has no clue on how to move companies in this direction. the savings were tremendous to the bottom line with our approach.

Remember in this industry the vendors set the standards and so called Best Practices. It's really funny to see a product with thousands of patches (HUH code that bad?). So the Best Practice guys write bad/broken code and in many instances do not use that same software to run their own companies.

We need to move towards a payment for a result business model and not a pay for billable bodies. Billable bodies just gives vendors no incentive to ever finish or do great work. They also tend to bring in lower level people at higher rates to increase the margins. So you want a pool in your back yard and they dig with teaspoons.

Want results hire the top tier, grand master developers and business people to get something done. Get those savings in months and not years. Also look for a bridge solution (like what we did above) that can be a subset solution that can go between existing systems for a quick result at a fraction of the cost.

ERP Fail: When Best Practices Meet Real Life « Farah Haddad on 21 February, 2011 at 12:00 am #

[…] Why do ERP projects fail so consistently? Many explanations have been put forward through the years, but here's one that may finally unravel the mystery [Read more] […]

William Wang on 21 February, 2011 at 1:48 am #

I used to be a BPR consultant. Now I am still in this field but with other engagements.

In my experiences, the most common failure rises from the mis-communication between the ERP vendor's sale team and the business owner. Sales team normally over promised while companies have various level of "systems readiness". It is difficult to evaluate how much the implementation actually costs. In order to win the bid, the sales normally competing by prices and the business owners think to get a great deal. No, no way. Cheaper price sometimes comes from the reduce of certain works (such as short period of process adjustment, systems customization, ….).

The pain will come after the adoption when the systems are not modified properly to fit the need of the business customers.

Sometimes the business owner/top management may not even sense tragedy for a while.

James Paulraj on 21 February, 2011 at 3:26 am #

One of the most common reasons for failure is the IT Manager responsible for the implementation. Some of these IT guys have got no knowledge of the business and operational requirements. Their arrogant attitude towards implementation by circumventing the opinions or suggestions of the real users, even if valid, results in less than desirable usage of the system and hence less derived benefits. One more reason is lack of clarity on what is expected from an ERP. This lack of imagination results in ERP systems being implemented and used like any other ordinary accounting package!!!

Sunilkumar Jha on 21 February, 2011 at 11:35 pm #
Dear Fotd,I am a man motivator with my experience that Fault lies with ERP abilities to perform as per my requirements. As Food must be to the taste of customer, same way it is important that ERP must be rich in features to with stand demands of
1 simple not complex to adopt
2 data reliability and accuracy
3 functional connectivity
4 modulation prospects
5 low servicing and maintainability

and then if it is more a problem then help,iwould not be for it-do n't call it my commitment-ERP features fail to inspire me-please work on them-i am ready to go all out for it. Regards

Hugh Pearson on 24 February, 2011 at 10:10 am #

The problems remain the same with Business Solutions implementations. Over the past 20 years, I have worked with a multitude of ERP implementations from small organisations to $18B multinationals.

My background consists primarily of Industry experience from the ground upwards. This allows me to relate with customers at a business rather than technical level, although I am fully technically certified also.

The ability for ERP implementers to implement business solutions and not technical solutions is paramount and closely correlated with the success and adaptation of their new systems. Having the knowledge and working experience in several roles within various business' is essential in understanding customer discussions and concerns. Only then can an implementer design processes and configure the ERP to align old processes, recognize new procedural requirements and provide the basic level of change management to win the trust of the clients at every level of the organisation that is affected by their new ERP.

Too often, I have had to be called upon to perform "Fly doctor" cleanups of ERP systems that have all the earmarks of "technical" implementations. The original implementers did not fully understand the client's business, their processes, the foreground knowledge of personnel roles, business Best Practices, professional Best Practices (GAAP, IFRS, MAPICs etc.) and the ability to relate to change management pyschology in the workplace.

To maximize the probability of success, the implementer must have practical business experience gained through years of working from the bottom up. Otherwise the client will only receive a technical implementation and a maximum success rate well below the customer's expectations. Managing customer expectations is also a critical exercise throughout the implementation cycle.

Compatability is reached when the implementer has walked in the shoes of the client and has the technical prowess to configure their ERP to reach the client business goals through the properly introduced processes performed by the employees of the client.

Best regards.

Mark Toomey on 26 February, 2011 at 8:59 pm #

Gabrielle Ford's work seems on track to prove one of the six principles for good governance of IT expressed in ISO/IEC 38500:2008 - the International Standard for Governance of Information Technology. The Human Behaviour principle exhorts organisaiton leaders to recognise and respect the human behaviour implications of any investment in IT as an enabler of change.

Infonomics experience of assessing organisations for alignment to ISO 38500 is that most organisaiotsn pay relatively little attention to this critical aspect of implementing change. Too many seem to still view IT as the silver arrow that obviates the need for them to pay equal attention to the other dimensions of change.

ISO 38500 defines five additional principles - Responsibility, Strategy, Acquisition, Performance and Conformance. The six provide a comprehensive framework in which organisaiotns can ensure that their current and future use of IT is efficient, effective and acceptable.

If Ms Ford would care to make contact, I will be happy to share more informaiton about ISO 38500 and assessments that have been undertaken.

Leslie Satenstein on 27 February, 2011 at 11:00 am #

Is not Best Practices, primarily the process improvements to ease the work of the employees? I define Best Practices as a process to implement functionality requested by the employee, to make the employee's job easier.

The side effect of this improvement is that once the employee can do his job well, he will look to adapt company operations to match supply chain interface (vendor/client) requirements to provide product and paperwork handling to generate cost savings to all.

Best Practices are also a mindset in an organisation. Rarely can it be imposed by top-down force. I believe it works best by bottom-up peculation. It should also provide rewards to employees who contribute to process improvement.

Jair Strack on 28 February, 2011 at 9:39 am #

The best article about ERP implmentation.

ejaz mian on 1 March, 2011 at 12:14 am #

erp is too much complicated and makes things more difficult than easy. debugging is cumbersome and not readily available

Richard Houlton on 1 March, 2011 at 2:35 am #

I've been implementing ERP systems of over 25 years and the problem is that you are putting in a "Whole Enterprise" system. You are bringing together key functional areas of a business, that often have been operating (sometimes adversarially) with a "silo mentality" (we don't care what these other folks are doing because we can't control them…let's just control our own patch) and you are asking all of these key functional areas, that often have a long history of mistrust, to arrive at a consensus and "play nice" together and share inputs/outputs to each others processes.

ERP implementations are emphatically not IT projects. They are 90% about People, Process, Culture, Politics and Leadership. They are 10% about IT. Treat an ERP implementation as an IT project and I guarantee that you'll be screwed straight out of the blocks.

Carl Franov on 1 March, 2011 at 7:43 am #

Richard sums it up nicely.
I'd like to add that the cost benefits dont come from headcount reduction which seem to be such a common thought process by management who should know better, the cost benefits come about from the ability to effectively Plan.

In a well conceived solution this can often be a problem, resentment and lack of adoption can come from the visibility that occurs in an ERP exposing dinosaur practices (Reactive rather than Proper Planning).

Any ERP implementation requires total executive management support whether you agree or disagree,(Need i say true leadership should be apparent) These implementations can sink companies, Fault to some degree can be laid at the doomsayers feet (Normaly wanting to save his/her empire, always the first to say i am behind you 1000%(I geuse they didnt stipulate that they are there pushing you under the bus), this is where the real trickle down effect starts.

The development and consulting team should be effectively managed by the business with experienced INDUSTRY implementors. Fixed pricing is not good for either party,

PGL Development is a must, Going Live to a turn key state is like moving into a new house, i still need to furnish the house, except in this case i cant use the old furniture.

Richard Houlton on 1 March, 2011 at 2:47 pm #

I am in table thumping agreement with Carl. And Carl, you are spot-on with the statement "resentment and lack of adoption can come from the visibility that occurs in an ERP exposing dinosaur practices". With properly implemented ERP there is nowhere to hide! Everything is exposed. Transparency is a significant point of the whole exercise!

ERP implementations fail because of lack of understanding, lack of proper engagement, and lack of leadership from the highest levels of management. End of story.

suz on 1 March, 2011 at 5:46 pm #

enjoy

Richard Houlton on 1 March, 2011 at 6:06 pm #

I thought about this more over night so I apologise for this long missive...

Doing ERP is an "Enterprise transforming" implementation and businesses doing ERP have to recognise this. If they don't really want to change anything then shouldn't start ERP in the first place.

Let's take the Finance Functional Area as one example. Fully integrated Financials where the Financial Reports are a dollars-and-cents reflection of what is happening in the transactional layers of the ERP is a cornerstone of ERP. ERP without integrated Financials cannot be considered to be an ERP system.

In non-ERP environments, Finance will build a fortress around the G/L and will filter, interpret and adjust (via journals) everthing that hits it. If somebody in purchasing with 10 thumbs types in the wrong price on a PO and generates $1m worth of Purchase Price Variance, finance can journal the problem away. In an ERP environment however, the correct way to fix this is to reverse the offending transaction and re-apply it correctly. The accountability for the problem is sheeted home to the person that made the mistake in the first place (so they can learn something from the experience) and the referential integrity and transparency of the ERP system is maintained. If Purchasing are alerted to their mistake (via out-of-tolerance exception reporting) they should have fixed the problem before Finance even spots it.

This requires departments to work together on identifying issues and identifying how to solve them. It also means that functions like Finance have to demolish the walls of the fortress and change their focus from "filtering, interpreting and adjusting" to working with the other functional areas of the business to ensure that the feeds to the G/L that they are generating through integrated ERP are producing the correct accounting (GAAP) entries. Finance has to sign off on every process in the system that results in a G/L journal being generated (which will probably be 90+% of the transactions in the system). This can be a total change of focus and operation in the

Finance department. It could require a complete change of roles and responsibilities and staffing levels. It could indicate that more people are required in the Purchasing Department and less are required in Finance. You can see how this sort of thing can get bogged down in cultural and political issues very rapidly! Actually, in my experience, Finance is often the biggest potential area for headcount reduction as a result of ERP!

Senior leadership have to be solidly engaged to understand scenarios like these and to appreciate that the implementation of ERP will turn over every rock in the organisation and expose every snake lying underneath. Senior leadership have to have the understanding, the resolve, and the guts to address the issues that get unearthed and be prepared to change things...and these things could include headcounts, accountabilities, roles and resposibilities, and even the ongoing suitability of particular individuals in the organisation. I have also seen ERP deployments suddenly highlight the non-viability of whole product lines and channels. Unfortunately, this "transparency" can also expose past decisions made by the leadership team! I saw one ERP implementation reveal (through the ability to do thorough activity based analysis without "smoke and mirrors" for the first time), that a CEO's high profile "pet project" was completely wrong-footed. No prizes for guessing the levels of leadership support that ERP project subsequently got!

You can't make an omlette without breaking eggs and ERP is an "Enterprise transforming" implementation. If senior leadership abrogate their responsibility to make the tough but necessary calls, I guarantee you that they will be sitting around in a year or two wondering why they blew $millions on an ERP implementation that achieved very little. And they'll probably also be sitting around at the club with other CEO's, cognac in hand, telling them what a crock ERP is and how they got burned by those b*****ds at SAP, Oracle, Microsoft, Lawson, QAD et al...

I think I may have been in this game for too long!

Internet Evolution - Executive Clan Editor's Blog - What Watson Can Do for the Enterprise on 2 March, 2011 at 9:04 am #

[...] risk assessments is high within enterprises. Nearly 70 percent of companies in an educational survey by the U.K.'s Open University report that enterprise resource planning (ERP) systems have fallen [...]

Gabrielle Ford on 4 March, 2011 at 10:18 am #

At first I was concerned that Richard Houlton was making a case against my research theories, but on second reading I think he is in support of the research, His comments appear to relate his experience and put forward an example in support of the following statement in the blog:

"In fact, it's your commitment to your OCoPs—a commitment generally considered a desirable quality in an employee—that sways real-world work practices, and quite possibly presents barriers to the effective transfer of knowledge required for the ERP system to succeed."

Richard seems to be saying that OCoPs (like Finance and Accounting) have never learned how to interoperate with other OCoPs although this is a prerequisite for ERP success. Richard, in your experience is this something that is generally overlooked with ERP implementations?

APPENDIX 5: REVISED MEASUREMENT MODEL ASSESSMENT

REVISED MEASUREMENT MODEL ASSESSMENT

	AVE	Composite Reliability	Cronbachs Alpha
ACS	0.8551	0.9465	0.9151
ACW	0.6075	0.8215	0.6747
AR	0.8594	0.9244	0.8380
OCS	0.8713	0.9713	0.9629
PA	0.6693	0.9094	0.8803
PU	0.8345	0.9724	0.9665
RES	0.7540	0.9382	0.9155
SA	0.7403	0.9343	0.9119
SC	0.7495	0.9228	0.8883
UK	0.7613	0.9053	0.8516
WPE	0.8220	0.9327	0.8918
WPI	0.7808	0.9342	0.9057
WPP	0.8853	0.9686	0.9564
WPT	0.6949	0.9009	0.8539

	ACS	ACW	AR	OCS	PA	PU	RES	SA	SC	UK	WPE	WPI	WPP	WPT
ACS1	0.8884	0.5220	0.2763	0.4367	0.0068	0.1114	-0.1887	0.1301	0.1772	0.5242	0.3178	0.3589	0.2467	0.4379
ACS2	0.9452	0.4664	0.2759	0.2578	0.0378	0.1415	-0.1441	0.2167	0.2031	0.5665	0.3427	0.3635	0.3067	0.4112
ACS3	0.9395	0.4621	0.2491	0.2166	0.0876	0.0874	-0.1620	0.1967	0.1447	0.5704	0.3159	0.3456	0.2755	0.3901
ACW1	0.2484	0.7017	0.1122	0.5168	-0.0464	0.0521	-0.1563	0.0205	0.1282	0.1794	0.0375	0.1576	0.1382	0.1927
ACW4	0.4858	0.8746	0.3480	0.5462	0.0006	0.3236	-0.2053	0.1282	0.3343	0.3359	0.2426	0.4237	0.3815	0.1371
ACW5	0.4739	0.7518	0.2661	0.4207	0.0220	0.0114	-0.2628	-0.1081	0.0996	0.3692	0.0504	0.2315	0.0761	0.3729
AR1	0.3119	0.2889	0.9116	0.1140	-0.0997	0.3196	-0.1432	0.1136	0.5667	0.3460	0.1844	0.4083	0.3146	0.2385
AR2	0.2347	0.3102	0.9422	0.1911	-0.1565	0.4160	-0.1285	0.2476	0.6496	0.3611	0.3708	0.4341	0.4017	0.1965
OCS2	0.2473	0.5974	0.1808	0.8935	-0.0034	0.1225	-0.1461	0.0639	0.2607	0.1221	0.2141	0.2911	0.2035	0.1461
OCS3	0.3423	0.6273	0.1370	0.9518	0.0420	0.1674	-0.0363	0.1534	0.2528	0.2185	0.2367	0.3208	0.1762	0.1306
OCS4	0.3292	0.5957	0.1715	0.9658	0.0211	0.1709	-0.0923	0.1300	0.2810	0.2462	0.2033	0.3609	0.2137	0.1434
OCS5	0.3078	0.5919	0.1749	0.9359	-0.0126	0.1980	-0.0831	0.1273	0.2768	0.2124	0.2525	0.3421	0.1852	0.1652
OCS6	0.3332	0.5490	0.1227	0.9183	-0.0086	0.1793	-0.0362	0.2222	0.2781	0.2264	0.2598	0.3115	0.2240	0.1153
PA1	0.1242	0.1195	-0.0647	0.0861	0.7838	-0.1069	0.1176	0.1117	-0.1882	0.1834	-0.1146	0.0129	-0.0289	-0.0753
PA2	0.0960	0.0450	-0.0495	0.0727	0.7019	-0.0399	0.1300	0.1967	-0.1564	0.0558	-0.0221	0.0130	-0.0375	-0.1246
PA3	0.0315	0.0172	-0.1326	-0.0183	0.8986	-0.1664	0.2506	0.1465	-0.2245	0.1213	-0.0976	-0.1014	-0.1017	-0.1827
PA4	0.0056	-0.0920	-0.1392	-0.0297	0.8955	-0.0843	0.3216	0.1833	-0.1908	0.0527	-0.0551	-0.0294	-0.0805	-0.2434
PA5	0.0093	-0.0160	-0.1426	0.0062	0.7937	-0.0774	0.2152	0.1085	-0.1674	0.0237	-0.0364	-0.0557	0.0241	-0.1986
PU1	0.1305	0.1737	0.3867	0.1409	-0.1070	0.9315	-0.1324	0.2303	0.5385	0.2150	0.3829	0.5008	0.7766	-0.0893
PU2	0.1564	0.2234	0.3940	0.1624	-0.1433	0.9453	-0.1674	0.2372	0.5248	0.2377	0.4145	0.5311	0.7966	-0.0903
PU3	0.1191	0.1504	0.4213	0.1343	-0.0983	0.9310	-0.2236	0.2197	0.5283	0.1771	0.3894	0.5090	0.7751	-0.0821
PU4	0.1082	0.1139	0.3582	0.1267	-0.1056	0.9167	-0.0708	0.2535	0.5200	0.1485	0.3996	0.4463	0.7190	-0.1349
PU5	0.0318	0.1428	0.2560	0.1355	-0.1153	0.8099	-0.0540	0.1790	0.4108	0.2401	0.2523	0.3849	0.5992	-0.0616
PU6	0.1676	0.2125	0.4001	0.1767	-0.1097	0.9586	-0.1814	0.2542	0.5763	0.2725	0.4269	0.5456	0.7941	-0.0697
PU7	0.0531	0.1913	0.3283	0.2769	-0.0871	0.8935	-0.0935	0.1592	0.5181	0.2151	0.3684	0.4644	0.7229	-0.1183
RES2	-0.0916	-0.1334	-0.0587	-0.0425	0.3610	-0.0768	0.7026	0.1971	-0.0814	-0.0499	-0.1154	-0.1266	-0.1457	-0.2741
RES3	-0.1801	-0.2610	-0.1532	-0.1359	0.2115	-0.1267	0.9361	0.2930	-0.0362	-0.0166	-0.0226	-0.1803	-0.2060	-0.3082

	ACS	ACW	AR	OCS	PA	PU	RES	SA	SC	UK	WPE	WPI	WPP	WPT
RES4	-0.1921	-0.2282	-0.1577	-0.0798	0.2124	-0.1576	0.9341	0.3009	-0.0137	-0.0152	0.0049	-0.2356	-0.2179	-0.2929
RES5	-0.1591	-0.2296	-0.1453	-0.0051	0.2464	-0.1430	0.8640	0.2744	-0.0298	0.0580	0.0595	-0.1751	-0.1934	-0.2464
RES6	-0.1434	-0.2882	-0.1028	-0.0939	0.2052	-0.1311	0.8837	0.2533	-0.0631	0.0003	0.0982	-0.1197	-0.1488	-0.3089
SA1	0.2165	0.1018	0.2990	0.2146	0.1334	0.3110	0.1779	0.8590	0.3922	0.3574	0.3569	0.2995	0.3447	-0.0430
SA2	0.1542	0.0704	0.1998	0.2195	0.1700	0.2666	0.2582	0.8930	0.3337	0.3306	0.3910	0.3228	0.3212	-0.1015
SA3	0.0737	-0.0278	0.1410	0.0717	0.2627	0.1437	0.2975	0.8579	0.1853	0.2456	0.4450	0.2026	0.2387	-0.1594
SA4	0.1613	0.0111	0.1288	0.0711	0.1441	0.1442	0.3240	0.9028	0.2425	0.3369	0.3945	0.2066	0.2520	-0.0720
SA5	0.2553	-0.0293	0.0881	0.0511	0.0468	0.1661	0.2613	0.7844	0.2525	0.2228	0.3248	0.1397	0.2326	-0.0396
SC1	0.2752	0.3573	0.4950	0.3654	-0.2022	0.5001	-0.0937	0.1681	0.8605	0.1934	0.3615	0.3480	0.4842	0.1545
SC2	0.1258	0.1931	0.5141	0.2736	-0.2236	0.5485	0.0323	0.2585	0.8809	0.2086	0.3090	0.2946	0.5039	0.0794
SC3	0.1308	0.1492	0.6779	0.1407	-0.1783	0.5108	-0.0294	0.3570	0.8910	0.3454	0.3533	0.4039	0.5506	0.1192
SC4	0.1197	0.1864	0.5937	0.2192	-0.1816	0.4087	-0.0727	0.3508	0.8294	0.2850	0.4162	0.3649	0.4349	0.1543
UK1	0.5668	0.3488	0.2931	0.1687	0.1129	0.0722	0.0236	0.1713	0.1330	0.8869	0.1906	0.2657	0.2216	0.2979
UK2	0.5891	0.3934	0.3365	0.1458	0.1189	0.0845	-0.0018	0.1536	0.1685	0.8814	0.2465	0.2507	0.2148	0.3139
UK3	0.4458	0.2819	0.3524	0.2364	0.0391	0.3641	-0.0215	0.4829	0.3978	0.8487	0.3617	0.4300	0.5316	0.1471
WPE1	0.3591	0.1626	0.2818	0.2599	-0.0298	0.4215	0.0212	0.3994	0.3907	0.2952	0.8847	0.3881	0.5219	0.0790
WPE2	0.3737	0.1707	0.3023	0.2544	-0.0963	0.3563	-0.0231	0.3874	0.3820	0.3230	0.9252	0.4039	0.4561	0.0934
WPE3	0.2144	0.0915	0.2540	0.1569	-0.0862	0.3468	0.0276	0.4299	0.3575	0.2604	0.9096	0.2869	0.4338	0.0439
WPI1	0.3205	0.2695	0.3129	0.1796	-0.0566	0.4186	-0.2261	0.2366	0.3082	0.2839	0.4036	0.8126	0.5086	0.1152
WPI2	0.3790	0.3411	0.4343	0.3955	-0.0553	0.4652	-0.1494	0.2469	0.3579	0.3221	0.3297	0.9322	0.4689	0.1814
WPI3	0.3780	0.3132	0.3702	0.3163	-0.0383	0.4351	-0.1364	0.2192	0.2778	0.3111	0.3463	0.9231	0.4508	0.1705
WPI4	0.2920	0.3573	0.4673	0.3214	-0.0316	0.5431	-0.1839	0.2695	0.4745	0.4215	0.3423	0.8614	0.6190	0.1096
WPP1	0.2860	0.2672	0.3369	0.2012	-0.0258	0.7373	-0.2299	0.3086	0.5273	0.3889	0.4888	0.5496	0.9456	-0.0035
WPP2	0.2655	0.2274	0.4137	0.1284	-0.1004	0.7699	-0.1808	0.2972	0.5269	0.3005	0.5249	0.5072	0.8903	-0.0010
WPP3	0.2723	0.2608	0.3617	0.2030	-0.0722	0.7976	-0.1986	0.3057	0.5560	0.4111	0.4805	0.5696	0.9747	-0.0251
WPP4	0.2997	0.2857	0.3591	0.2723	-0.0382	0.7591	-0.1888	0.3084	0.5360	0.4387	0.4702	0.5702	0.9510	-0.0173
WPT1	0.3696	0.2131	0.1316	0.0897	-0.1301	-0.2451	-0.0418	-0.0935	0.0103	0.2395	-0.0181	0.0293	-0.2137	0.7754

	ACS	ACW	AR	OCS	PA	PU	RES	SA	SC	UK	WPE	WPI	WPP	WPT
WPT2	0.3746	0.2308	0.2016	0.1291	-0.1480	-0.0854	-0.2786	-0.0434	0.1269	0.2873	0.0429	0.1117	0.0448	0.8898
WPT3	0.2910	0.1393	0.2239	0.0773	-0.2590	-0.0410	-0.2316	-0.0530	0.1901	0.2339	0.1059	0.0802	0.0314	0.8550
WPT4	0.4370	0.3360	0.2081	0.1829	-0.1947	0.0029	-0.4712	-0.1298	0.1523	0.1605	0.1208	0.2741	0.0614	0.8097

	ACS	ACW	AR	OCS	PA	PU	RES	SA	SC	UK	WPE	WPI	WPP	WPT
ACS	0.9247													
ACW	0.5254	0.7794												
AR	0.2901	0.3238	0.9270											
OCS	0.3350	0.6344	0.1685	0.9334										
PA	0.0456	-0.0082	-0.1411	0.0086	0.8181									
PU	0.1235	0.1903	0.4014	0.1802	-0.1197	0.9135								
RES	-0.1794	-0.2652	-0.1455	-0.0837	0.2789	-0.1483	0.8683							
SA	0.1944	0.0316	0.2019	0.1497	0.1816	0.2410	0.3065	0.8604						
SC	0.1904	0.2580	0.6596	0.2891	-0.2265	0.5681	-0.0492	0.3268	0.8657					
UK	0.5986	0.3823	0.3816	0.2210	0.0946	0.2350	-0.0040	0.3493	0.2988	0.8725				
WPE	0.3526	0.1583	0.3092	0.2498	-0.0769	0.4155	0.0090	0.4467	0.4167	0.3244	0.9067			
WPI	0.3860	0.3661	0.4550	0.3491	-0.0507	0.5320	-0.1957	0.2768	0.4091	0.3842	0.3999	0.8837		
WPP	0.2985	0.2768	0.3905	0.2145	-0.0627	0.8143	-0.2121	0.3241	0.5704	0.4099	0.5215	0.5841	0.9409	
WPT	0.4488	0.2861	0.2319	0.1502	-0.2201	-0.1010	-0.3289	-0.0995	0.1477	0.2719	0.0806	0.1628	-0.0127	0.8336

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